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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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DR. LLOYD'S "TREATISE ON MAGNETISM"

A Treatise on Magnetism, General and Terrestrial. By Humphrey Lloyd, D.D., D.C.L., Provost of Trinity College, Dublin. (London: Longmans and Co., 1874.)

AN observational science like meteorology or terrestrial magnetism is placed in some respects at a disadvantage when compared with the more experimental branches of physical inquiry. It is often difficult to obtain a good and readable account of that which has been done. The reason of this is, that those who are personally engrossed with the science have to deal with such large masses of figures and precise measurements that they are frequently unable to spare the time necessary to give a good historical account of their favourite research. Those again who are the historians of science find it a very formidable task to bring themselves *en rapport* with all that has been done in such a subject as terrestrial magnetism—in fine, there is not sufficient inducement to undertake the task. No doubt, when such a science is more advanced and has attained a position like that of astronomy, it will find plenty of historians; but in its infancy, and when a good *résumé* of the progress already made is of peculiar value, it has comparatively few friends. Now these are precisely the circumstances when a Government or a University is able to interfere with very great effect, and with respect to terrestrial magnetism this opportunity has been admirably used by Trinity College, Dublin. The Rev. Dr. Lloyd tells us in his preface that the Dublin Magnetic Observatory was founded and placed under his superintendence by the governing body of Trinity College in 1838. This college has been peculiarly fortunate in having chosen as an observer the eminent physicist who is now its provost, and who, besides reaping much fame as a practical magnetician, has at length found leisure to present us with the much-required treatise on terrestrial magnetism.

The first part of this work refers to the general phenomena of magnetism, and contains one of the clearest accounts of the elementary laws of this subject which we have ever read. Some of the experiments recorded we do not remember to have seen anywhere else.

One of the most interesting preliminary chapters is that on the effects of temperature. It is well known that heat has a very peculiar effect upon all magnets. The following paragraph from Dr. Lloyd's work will explain the particulars of this action:—

"Heat is also found to weaken the coercitive force of iron, and therefore to facilitate its magnetisation and demagnetisation. When a bar of iron is heated and exposed to the inductive action of a strong magnet, the magnetism developed is augmented. This effect increases up to a *dull red* heat, at which it is a *maximum*. At a *bright red* heat the capability of induction ceases altogether. *Cast-iron* and *steel* present the same results. The maximum force imparted to soft iron has been found by M. Ed. Becquerel to be 1·04, that imparted at the ordinary temperature of the air being unity; and it is a remarkable circumstance that the maximum force induced in *cast-iron* and in *steel* is precisely the same as that of *soft iron*, although at ordinary temperatures their induced magnetisms are very different. It appears from these facts that the coercitive force of these bodies vanishes altogether at a *dull red* heat" (p. 23).

Although it may be convenient to speak of the magnetic fluid, yet we think there can be little doubt that in a magnet we have directed molecular motion of some kind. This, we believe, is the hypothesis held by Sir W. Thomson and other physicists. The author of this notice has ventured to bring forward certain views as to the action of heat in destroying all directed motion. We know, for instance, that the conduction of electricity and of heat, two forms of directed molecular motion, is more resisted at high than at low temperatures. The analogy urged to explain this was that of a carriage or train in motion, on a road lined with passengers who were constantly entering at the one side while they were passing out of it at the other.

A stream of passengers of this nature would have the effect of bringing the directed motion of the train ultimately to rest. Now, heat may affect directed molecular motions in the same way, carrying into the train matter which does not partake of the motion of the train, and carrying out of the train matter which does partake of this motion, and so weakening the velocity of the train. Even visible directed motion may be influenced in this way, and it does not seem improbable that the etherial medium may act after this fashion in stopping the differential motions of the universe.

Now the question arises, is it likely that we have any action of this nature traceable in the effects of heat upon magnetism? Let us again quote from Dr. Lloyd as to certain peculiarities of the action of heat:—

"When the heat applied to a steel magnet is moderate—when, *e.g.*, it does not exceed that of boiling water—part of the magnetism which had disappeared on the increase of temperature reappears when the original temperature is restored. It follows from this that heat produces two effects, which (in the present state of our knowledge) must be considered as distinct.

"Like mechanical action, it permanently *destroys* a portion of the existing magnetism by enabling the two magnetisms which had been separated in each molecule to recombine. And, on the other hand, it *renders latent*, or neutralises, another portion of the same magnetism, which portion reappears again when the temperature is reduced to its original state.

"This two-fold operation of heat, although fully recognised as a fact, has not been sufficiently considered in reference to the cause. There seems reason to believe that the two effects, so dissimilar in their conditions, are, in fact, referable to distinct causes; and that while the permanent loss of magnetism is a *dynamical effect* due to the *molecular movement* in which heat is known to consist, the recoverable portion is probably to be ascribed to the *dilatation* of the body and to the diminution of the reciprocal action of the magnetic elements consequent upon their increased distance."

We quite agree with Dr. Lloyd in his remarks on these two effects of heat, and would venture to supplement them with a suggestion as to the possibility of regarding the *dynamical effect* of heat as due to the introduction of new matter—new passengers, as it were—into the directed train of magnetic motion. If this view be tenable, we may perhaps imagine that a permanent loss of magnetism will be occasioned by every change of temperature of the magnet, whether this be from a lower temperature to a higher or from a higher temperature to a lower; in fact, as far as we can see, all the experiments hitherto made are just as compatible with this supposition as with

that which attributes a permanent loss of magnetism only to an increase of temperature.

We now come to the most valuable part of the work, or those chapters which treat of terrestrial magnetism. Dr. Lloyd tells us in his preface that the course he has pursued has been "to present the results obtained at a single station, *i.e.* Dublin, at which all the general features of the phenomena belonging to the middle northern latitudes were fully developed, and to supplement the information by the results of observation at places widely removed from the former in geographical position, as well as in their relation to the sun's daily and yearly courses."

Dr. Lloyd adds that "he has not entered upon the interesting speculation connected with the physical causes of the phenomena, further than to reprint a paper, published by himself many years ago, in which the agency of the sun and moon are shown not to be due to their direct operation as magnetic bodies." And he concludes his preface by remarking that "the electrical earth-currents must have their effect upon the magnetical variations recorded in our observatories, whether they be the sole, or only a co-operating cause."

Are we justified in our inference, from the concluding observation, that Dr. Lloyd has to some extent modified his views with regard to the importance of these earth-currents? for, if we are not mistaken, he was at one time inclined to attribute the daily variations of terrestrial magnetism to their operation.

Speculations regarding the causes of the phenomena of terrestrial magnetism may be divided into two classes: firstly, those which attempt to account for the magnetisation of the earth; and secondly, those which only pretend to account for the changes taking place in this magnetisation. It is from the latter point of view that we would now venture to make a few remarks.

Let us assume, to begin with, that nothing is definitely known regarding the causes of these changes. Let us next endeavour to enumerate and discuss the various agencies we know of which may be conceived to take a part in producing these phenomena, in the hope that by a preliminary trial of its kind we may, perhaps, light upon the true cause, even although the evidence at our disposal be insufficient to give certainty to our suspicions.

In the first place, we may take it for granted that neither the sun nor the moon can cause the changes in terrestrial magnetism, which they are known to produce, by virtue of their direct magnetic influence.

This point has been sufficiently discussed both by Dr. Lloyd and by Mr. Chas. Chambers, and the conclusion to which both of these magneticians have arrived is, that the magnetic effects caused by the sun and moon are not due to their direct operation as magnetic bodies.

Let us take the sun and confine ourselves in the meantime to the daily variations which he causes. Now, first of all, it is clear that these are not due to any kind of tidal action of the sun, or to the indirect consequences of such an action, inasmuch as there is only one maximum and one minimum in the day.

The only other known way in which the sun can affect the earth is through his heat; and starting with the assumption that the earth *is* a magnet, no matter how or why, let us next enumerate the various ways in which the heat of the sun may possibly affect the earth.

In the *first* place, it might influence the magnetic properties of that medium (the air) which surrounds the earth and any suspended magnet.

Or, *secondly*, it might produce a temperature effect upon the earth itself considered as a magnet.

Or, *thirdly*, it might be conceived to generate thermo-electric currents in the earth.

Or, *fourthly*, it might cause the motion of conducting bodies across the earth's lines of magnetic force.

The first of these is the hypothesis of Faraday; and while the change produced by heat in the magnetic qualities of the atmosphere cannot be without its influence, yet it is, we believe, the universal opinion of magneticians that this change cannot account, either in magnitude or law, for the somewhat considerable daily variation. The diurnal change produced by the sun's heat in the magnetic condition of the crust of the earth must be still more insignificant, and may be at once dismissed.

Our attention is thus concentrated on the third and fourth of the above possible causes, one of which we may perhaps expect to account for the daily variation, unless this be due to some cause of the nature of which we are entirely ignorant.

It is now well known that what are called earth-currents are of very frequent, if not continuous occurrence, and we are indebted to the present Astronomer Royal for an experiment made with the view of ascertaining the nature of the relation between these currents and the changes of terrestrial magnetism. He set up certain wires on the Croydon and Dartford lines, which gave him, by means of a self-recording arrangement, a continuous record of the strength and duration of these earth-currents, and the following is the conclusion which he has derived from the discussion of these observations:—

"Neither in magnitude nor in law are these inequalities consequent on the galvanic currents competent to explain the ordinary diurnal inequalities of magnetism."

In fact, there is some reason to regard these currents rather as the *effects* than as the *causes* of magnetic changes, that is to say, to view them as secondary currents; and the author of this notice has shown in a paper, published in the Transactions of the Royal Society of Edinburgh, that these earth-currents are strongest at those periods of the day when the change in terrestrial magnetism is most rapid—a result which would follow if the earth-currents were secondary currents due to magnetic changes. Our attention is thus drawn to the fourth hypothesis as the only remaining conceivable cause of magnetic changes, unless these are caused by something of which we are entirely ignorant.

It is known that Faraday tried to detect induction currents in the Thames, supposing that these might be caused by the carriage of a conducting liquid across the earth's lines of magnetic force, but found no positive result. Sir W. Thomson afterwards made a proposal to test the idea by tides in the English Channel, but we do not think this has ever been carried out. He also discussed to some extent the part which may be played in the phenomena of terrestrial magnetism by moving conductors.

But to return to the fourth hypothesis. In the first place, let us ask ourselves the question, Under what circumstances can the convection currents generated by the

sun's heat become conductors? Now, this can only take place in the upper and rarer regions of the atmosphere, since dense air is manifestly a non-conductor. We have therefore in the upper regions of the air a conductor—rare air—conveyed across the earth's lines of force by the convection due to the sun's heat, probably with a very considerable velocity. Now, is it not possible that these moving conductors may have currents generated in them which will act upon the magnet both directly and through the earth? As far as we are aware no attempt has yet been made to treat the question mathematically; indeed, we are hardly prepared for that at present, since we know very little about the convection currents in the upper regions of the earth's atmosphere.

We may perhaps, however, deduce the laws of the upper convection currents from what we know of the lower currents. Now, there are several points of similarity between the convection currents as we know them and the daily magnetic variations. The *first* in order is that noticed by Mr. Baxendell, who observed a very strong likeness between the daily behaviour of the wind and that of the magnetic declination.

The *next* is a resemblance between what we know takes place near the equator as regards the magnetic declination and what we imagine must take place as regards the upper convection currents. Sir E. Sabine has shown that near the equator the diurnal magnetic change is of an opposite character during the two halves of the year reckoning from the equinoxes, so that it is only at or near the equinoxes that the diurnal inequality might be expected to vanish as it passes from the one phase to the other. Now, we should quite expect something of this kind if the diurnal changes were due to convection currents; and just as the change which we might expect in the convection currents of these regions on account of the motion of the sun in declination would probably not be gradual, but of a hesitating or oscillatory character, so Mr. J. Allan Broun has found from his magnetic observations at Trevandrum (page 180 of Dr. Lloyd's work) that the magnetic change is not a gradual or regular one. This is a very important remark, and if followed up by a thorough discussion of the various tropical magnetic observations, may be expected to throw much light on the cause of the daily variation.

The third point we would notice is a peculiarity in the behaviour of the daily magnetic variation near the magnetic pole.

"The observations of Sir Leopold M'Clintock in 1858—59, at Port Kennedy," says Dr. Lloyd, "have enabled Sir Edward Sabine to throw further light upon the laws of the diurnal variations. The declination at Port Kennedy is N. 136° W.; while that of Point Barrow is N. 41° E. The north poles of the needles at the two stations, which are at opposite sides of the earth's magnetic pole, thus point in opposite directions. Now, when disturbances are removed, the observations gave the greatest deflections at 8 A.M. and 2 P.M., as in other places. But they showed, further, that the positions were referred in both to the *magnetic meridian* of the place, and not to the *astronomical*; the deviations of the magnet at 2 P.M., for example, being in both places *to the left* of an observer looking towards the magnetic pole at each place, and therefore *geographically* in opposite directions."

Now, meteorologically, the north magnetic pole is not far from the pole of greatest cold, and we might, perhaps, expect on opposite sides of the pole to find the upper convection currents going in opposite directions. If this be the case, and if the daily variation be due to those currents, then we might also expect a magnetic behaviour such as was deduced by Sir E. Sabine from the observations of Sir L. M'Clintock.

We think, in fine, that the behaviour of the daily variation at the tropics, at middle latitudes, and near the magnetic pole, is not inconsistent with the hypothesis that such variation is due to convection currents. But if this hypothesis be true, it cannot be limited to the daily variation. We know very well that the currents of the earth's atmosphere often present great irregularities, and that these irregularities are especially prevalent at the equinoxes. Now, we have a precisely similar peculiarity in magnetic changes. These are frequently irregular, and their irregularities are greatest at the equinoxes. In proof of this we extract the following table from Dr. Lloyd's work:—

Annual variation of the mean disturbance at Dublin.

Month.	Mean Disturbance.	Month.	Mean Disturbance.
January	0·48	July	0·57
February	0·57	August	0·56
March	0·58	September	0·67
April	0·57	October	0·66
May	0·52	November	0·59
June	0·48	December	0·45

The next point to which we would allude is a similarity between the secular variation of the meteorology and magnetism of the earth. Mr. Baxendell, we think, was the first to point out that there is a change in the convection currents of the earth, depending on the state of the sun's surface with regard to spots; and Mr. Charles Meldrum has followed with the very interesting and important announcement that we have most frequent cyclones in the Indian Ocean during years of maximum sun-spots; and finally, M. Poey has shown that there is a similar correspondence between sun-spots and the hurricanes of the West Indies. In fine, we have here an intimate connection between solar and terrestrial meteorology. But we have also a connection between sun-spots and magnetic disturbances; and Sir E. Sabine was the first to point out that during the years of greatest sun-spots we have the greatest disturbance of terrestrial magnetism. Now, may not the increase of magnetic disturbance be due to the increase of meteorological disturbance which the sun somehow produces, the upper convection currents influencing the magnet in the manner above stated?

It is probable, however, that some will raise the following objection to this hypothesis. When there is a great magnetic storm or disturbance, this takes place simultaneously and abruptly throughout the whole earth; now, how can this be the result of a meteorological commotion?

We would reply to this objection that magneticians have begun to recognise two sets of disturbances.

When the writer of this notice was at the Kew Observatory, this was forcibly brought before him. There are disturbances of a rounded character, and there are others which are exceedingly abrupt; and we think that Senhor Capello has shown that these rounded disturbances are

certainly not simultaneous between Kew and Lisbon. The abrupt disturbances constituting magnetic storms are, however, probably simultaneous all over the world. It is thus possible to imagine the former or rounded disturbances to be caused by convection currents, but it is quite impossible to regard the latter as so caused. How, then, can these be accounted for consistently with this hypothesis? We reply, that when there is a considerable disturbance in the convection currents of the earth, these currents, as we have explained, conveying electricity, we may then expect such currents to influence and alter the magnetism of the earth. The earth gets out of relation as a magnet to these currents, and rights itself abruptly; and this abrupt change of the earth occurring simultaneously all over it, may form the second kind of magnetic storm.

Corresponding to these two varieties of magnetic disturbances, we have, in all probability, two kinds of auroras.

The upper convection currents of the earth, if they convey electric currents, may probably be self-luminous, and this may account for auroras of a local nature, and perhaps also for the nearly perennial displays of auroras near the magnetic pole.

On the other hand, whenever we have an abrupt magnetic storm we have the production of secondary currents due to the small but abrupt changes taking place in the magnetism of the earth, and these secondary currents will manifest themselves both in the upper strata of the earth's crust, which are conductors, and in the upper strata of the earth's atmosphere, which are also conductors. In the former case they will produce violent earth-currents; in the latter they will produce a magnificent auroral display, cosmical rather than local in its characteristics.

We have already alluded to the Greenwich self-recording instruments for registering earth-currents, and the author of this notice has inspected several of the curves given by the Greenwich instruments during violent magnetic storms. The characteristic of these traces is an abrupt and violent change from positive to negative and from negative to positive. Now, this is a behaviour quite in accordance with the hypothesis that these are secondary currents due to magnetic changes, but quite inconsistent with the hypothesis that they are themselves the causes of such changes.

Altogether, we would venture to conclude, *firstly*, that if the changes of terrestrial magnetism are not due to some such cause as that which we have stated, then they must be due to some cause of which we are entirely ignorant; and, *secondly*, that the laws of the magnetic changes are, in all the points we have examined, consistent with the idea that they are due to the carriage of conductors across the earth's lines of force.

B. STEWART

SIMON'S "SPIDERS OF FRANCE"

Les Arachnides de France. Par Eugène Simon, Vice-Président de la Société Entomologique de France. Tome premier. (Paris, 1874.)

EXCEPTING two or three, either partial or abortive, attempts at the early part of the present century, by Baron Walckenäer, no effort has, until now, been made to supply a history of the spiders indigenous to France. This is the more remarkable, inasmuch as, though Arachnology has but few votaries in any country, yet England, Sweden, Prussia, and even Italy, have furnished more or less complete works on their respective spider-faunas. Looking again at the geographical position of France, perhaps few other equal areas would give such a promise of rich results to the araneologist; with all the advantages of an insular position, France combines those of the general Continent of Europe; and her climate ranges from the sub-arctic, in her mountain regions, to the semi-tropical on the Mediterranean shores. We may confidently, therefore, expect a vast addition to our knowledge of European spiders from the labours of the industrious author who has stepped into the breach, and whose first volume on the Spiders of France stands at the head of this notice.

As its title implies, the work is intended to embrace more than the one order (Araneidea) of Arachnids; certainly (it is understood) the orders Scorpionidea and Phalangidea; but whether it will extend also to the other orders, is yet undecided. The present volume, pp. 1-269, Pl. i. ii. iii., embraces five families of the order Araneidea (or Araneæ). It is a matter of regret that it had not been practicable to retain a systematic sequence in regard to the details of the order; the reason given for this is that the author has taken first those families of which he was in possession of the amplest materials; another drawback also seems to be, that the Introduction, "comprising general remarks on the class Arachnida and its bibliography," will not appear until later; when it will, however, be specially paged for addition to the first volume. The volume before us begins with a useful glossary of special terms used in the descriptions; to this follow (pp. 5-15) some general remarks on the characters of the order ARANEÆ, and some criticisms on the more extended works of different authors upon it; concluding with the outlines of the classification adopted in the present work. In regard to classification but little alteration is proposed from that contained in a paper, "Aranéides nouveaux ou peu connus du Midi de l'Europe, 2e mémoire," by the author,* published (according to the title-page of its author's presentation copies) in 1873, in "Mémoires de la Société Royale des Sciences de Liége."

For the principles of M. Simon's primary divisions of the Araneidea we are referred to the second memoir above mentioned; there, after giving his reasons for dissenting from the primary divisions adopted by Dr. Thorell in his work "On European Spiders," the author divides the Araneidea into four sub-orders:—1. THERAPHOSÆ; 2. GNAPHOSÆ; 3. ARANEÆ; 4. OCULATÆ. The sequence of these is reversed in the volume before us; the name of the third is changed to *Aranеæ veræ*, and of the fourth to *Aranеæ oculatæ*. The addition to the name of the third order was necessitated by the adoption of the term Araneæ

* This paper does not, however, appear yet to have been "published" in the only true acceptation of the term; that is, *offered to the public for sale*; and, it is understood, will not be so published until 1875. This is in some respects a matter of importance, inasmuch as the claim of many species and some genera to the names under which they are, or will be, characterised in the present work, rests for their priority upon the date of publication of the above paper in the Mém. Liége. Similar remarks apply to the 1e Mémoire on "Aranéides du Midi de l'Europe," the presentation copies of which were issued in 1870, while the volume containing it was not published until 1873.

(Sundevall) as the name of the whole order, in lieu of Araneidea—Aranéides. With regard to this change, it has the opinion and authority of Dr. Thorell in its favour; and something may be said for it on its own merits; but still, similar terminations (such as in the present instance the ordinal termination -eidea, in the class Arachnida), when adopted for the designation of parallel groups in nature, are of considerable use in fixing the necessary framework of classification in the mind. The grouping, however, of the different families in M. Simon's four sub-orders will, we may anticipate, hardly find much favour among araneologists. The "Araneæ veræ" form an exceedingly heterogeneous group, including as it does spiders so widely separated as the Thomisides and Pholcides! The "Gnaphosæ," also, consisting only of the Dysderides and Scytodides, comprise two very distinct groups, with little in common except the number of the eyes, and the mode of adaptation of the palpal organs to the digital joints of the male palpi; characters found also among the "Araneæ veræ," as well as among the "Theraphosæ."

With respect to the distinguishing characters given of the sub-orders "Araneæ veræ" and "Araneæ oculatæ" (*Yeux diurnes* and *Yeux nocturnes*)—the former coloured and convex, the latter vitreous and flattened—some detailed proof of these differences producing the results asserted would seem to be necessary. Differences, indeed, there are between the eyes of various spiders: some are undoubtedly flattened, some misshapen, and, as in the genus *Œcobius*, apparently more or less aborted; some also are of a pearly-white lustre, some dark, and others brilliantly coloured; but that the eyes of spiders may be distinguished as nocturnal or diurnal by the presence or absence of colour, is an idea at least opposed to the views of an eminent insect anatomist, M. F. Müller, who, as long ago as 1826, "Zur Vergleichenden Physiologie des Gesichtssinnes," wrote against M. Marcel de Serres in regard to a similar point among insects. Apart, however, from this point, it would seem scarcely necessary to attempt the very difficult task of dividing into sub-orders a group so homogeneous as the order Araneidea.

The linear arrangement of the families adopted by M. Simon is very natural, and the interpolated names of his Sub-orders appear to be of little assistance as mere divisional marks, while their scientific tenability seems also, as hinted above, very questionable. M. Simon, while attributing confusion of mind to Dr. Thorell (Note 1 to p. 10) in regard to his notions respecting Orders and Families, appears to have himself fallen into some confusion in regard to the difference between Orders and Sub-orders; in the note above quoted these two kinds of groups are spoken of as though of equal significance in classification, and as being similarly characterised. An Order, however (characterised by complications of structure common to all the families of which it is composed), limits a group within a CLASS; while the Sub-order limits a group within the Order; a group distinguished differentially from the Order by some special complications of structure peculiar to itself. Each of M. Simon's four Sub-orders should, consistently with his definition of those groups, be based "Sur un caractére anatomique profond, indépendant de la forme, mais indiquant une supériorité ou une infériorité dans les limités de la classe." When we turn, however, to the characters given (in the Mémoire before quoted), we find some considerable details given under each of the Sub-orders; but the special anatomical character indicating the superiority or inferiority of each is not apparent. If the difference between *Yeux diurnes* and *nocturnes* be the character intended, no mention is made of it in respect to the Theraphosæ, while the *Araneæ veræ* possess eyes of both kinds, "the two central eyes of the first row are diurnal, the other six nocturnal." And even supposing these characters to be good and constant, it is not easy to see what superiority or inferiority is indicated by them. All recent investigation tends to lessen the value of characters taken merely from the eyes of spiders, for higher divisional purposes. Supposing they are so, all we could say is, that they are modified and adapted to the habits of the different spiders, and are thus, at most, valuable for *specific* determinations.

Passing on to the body of the work, we find good terse descriptions of 131 species of spiders distributed among the six families—Epëiridæ, Uloboridæ, Dictynidæ, Enyoidæ, and Pholcidæ; the genera comprised in these being twenty-three in number. The genus *Epëira* absorbs thirty-nine out of the seventy-four species contained in the whole family EPËIRIDÆ, the remainder being distributed as follows:—*Peltosoma*, 2; *Argiope*, 2; *Cyrtophora*, 1; *Cyclosa*, 5; *Larinia*, 2; *Singa*, 8; *Cercidia*, 1; *Zilla*, 6; *Meta*, 3; *Tetragnatha*, 5. In the family ULOBORIDÆ are four species distributed between two genera: *Uloborus*, 3; *Hyptiotes*, 1. The family DICTYNIDÆ contains thirty-six species, distributed among four genera: *Dictyna*, 14; *Lethia*, 5; *Titanœca*, 7; *Amaurobius*, 10. The family ENYOIDÆ comprises three genera and eleven species: *Ceto* (gen. nov.), 1; *Selamia*, 1; *Enyo*, 9; while the last of the families contained in the present volume, PHOLCIDÆ, has three genera and five species: *Holocnemus*, 1; *Pholcus*, 2; *Spermophora*, 2.

The above families are characterised at considerable length, and the diagnoses of genera are terse and good. An analytical table, with cross references of the chief characters of all the families intended to be included in the work, is given at page 14; similar tables are also given of the genera and species; of some of the genera, separate tables of the males and females are given.

Of the twenty-three genera contained in this first volume, two—*Larinia* and *Ceto*, in the family Enyoidæ—are characterised as new. The species described as new are sixteen in number: six in the family Epëiridæ, genera *Larinia*, *Epëira*, and *Tetragnatha*; eight of Dictynidæ, in the genera *Dictyna*, *Lethia*, *Titanœca*, and *Amaurobius*; and two of Enyoidæ, in the genus *Enyo*. The semi-tropical character of the present portion of the spiders of France may be noted in the genera *Peltosoma*, *Argiope*, *Cyrtophora*, *Ceto*, *Selamia*, *Enyo*, *Holocnemus*, and *Spermophora*.

The plates illustrating this volume—three in number—are engraved on copper, and reflect great credit on both the artist (M. Simon himself) and the engraver. The figures, not too small, are yet remarkably clear, and all the minute points of form, structure, and pattern, are exceedingly well defined. One only regrets that the number of species illustrated should be, perhaps

necessarily, so limited; a type only of each genus being represented, with some few structural details of others. Figures, such as those here given, of all the species comprised in the work, would make it one of the most valuable and important faunistic works on spiders that have been published for many years. In spite, however, of this, probably inevitable, drawback, we hail this volume with great satisfaction, not only for what it is in itself, but as an earnest of what we hope is to follow before any great lapse of time. A second volume, containing four more families—Urocteoidæ, Agelenidæ, Thomisidæ, and Sparassidæ—is announced for April next; and it is considered that four or five volumes in the whole will complete the work.

ANTHROPOLOGICAL NOTES AND QUERIES

Notes and Queries on Anthropology, for the Use of Travellers and Residents in Uncivilised Lands. Published by a Committee appointed by the British Association for the Advancement of Science. (London: E. Stanford, 1874.)

WELL asked is half answered, and more problems escape solution because no one happens to propose them, than because of their real difficulty. To suggest suitable inquiries to the mind of a traveller or colonist as to the wild races he comes in contact with, is to start him on a course of ethnological investigation which may lead to excellent results. The plan of drawing up lists of such inquiries to be distributed among naval officers, missionaries, and others, is not new. The Ethnological Society of London issued a set years ago, which drew much information. An elaborate series of questions as to the North American tribes, answers to which constitute some of the best material in Schoolcraft's "Indian Tribes of the United States," is reprinted at the end of vol. i. of that work. The "Admiralty Manual of Scientific Inquiry" contains an ethnological section, first drawn up by Dr. Prichard, and since revised. The present publication issued by the British Association is far more complete than any of these earlier guides. The committee by whom it has been drawn up are Col. Lane Fox (secretary) Dr. Beddoe, Mr. Franks, Mr. F. Galton, Mr. E. W. Brabrook, Sir J. Lubbock, Sir Walter Elliot, Mr. Clements R. Markham, and Mr. E. B. Tylor. The first sections, relating to the physical constitution of man, are drawn up by Dr. Beddoe, who gives drawings and directions for measurement of skull and limbs, &c. It adds much to the value of the book that the eminent French anthropologist, Dr. Broca, has allowed his set of colour-types to be reproduced. By the aid of these tinted patches, the colour of skin, hair, and eyes in individuals of any race may be set down within a shade. Thus, instead of loosely describing a Peruvian Indian's complexion as copper-brown, it might be defined as between No. 42 and No. 43 of Broca's table. The section on archæology is by Col. Lane Fox, and contains cuts of the principal types of stone implements, contributed by Mr. John Evans, also an ideal representation of a valley, to show the position of the gravel beds above the present river-level, where travellers may be likely to find drift-implements. The sections on war, hunting, and ornamentation are also by Col. Fox; the latter article is especially interesting from the illustrations of the principal patterns used in barbaric ornamental carving, &c., such as the chevron, fret or key-border, plait or guilloche. Mr. Franks deals with the subjects of clothing, personal ornaments, pottery, &c.; Mr. Evans with weaving, basket-work, &c.; Mr. Galton with statistics; Sir J. Lubbock with relationships; Mr. Tylor with religion, mythology, language, customs, &c.; Prof. Busk with artificial deformations; Prof. Carl Engel (whom the printer has converted into *Cave* Engel) on music; Mr. Hyde Clarke on weights and measures, money, &c. The articles often contain not only leading questions, but introductions which state in few words what is known on their subjects.

We strongly recommend those who have friends within reach of uncivilised countries to send them out at once copies of this little manual. Being not a regular trade publication, but issued by a scientific body, it may very likely fall out of print when the first stock is exhausted.

OUR BOOK SHELF

Lessons in Elementary Botany. New Edition. By D. Oliver, F.L.S., F.R.S. (Macmillan and Co., 1874.)

THE new edition of this admirable little text-book deserves a word of notice. It is slightly enlarged, the additions principally dealing with the most important points in economic botany. The illustrations have been increased in number, and the few small errors which had crept into the first edition have been corrected. In the present state of our classificatory knowledge of flowering plants, it would be hardly possible to have a better guide than Prof. Oliver's "Lessons." Something, doubtless, will still have to be supplied by the oral instruction of the teacher. No series of natural objects ever was or ever will be quite comfortable when packed into a classification. The exposition of the term *perigynous*, for instance, requires that the pupils should be not exacting, but reasonable; there have been found even grown-up and advanced botanists who have allowed themselves to be sceptical about the application of the term to the corolla of the common Holly. They have even ventured to go so far as to wonder how the insertion of the corolla would differ in this case if it were *hypogynous*.

The few pages at the end of the book devoted to Cryptogams have been slightly enlarged, but are still not perhaps intended to more than indicate the existence of other types of vegetable life besides Phanerogams. If the criticism may be allowed (and it really seems ungracious in a case like the present), it would have been better not to apply the term Order to groups differing so widely in their relative diversity as, say, *Cyperaceæ* and *Gramineæ* on the one hand, and *Musci* and *Fungi* on the other. On no possible modern classificatory principles can such aggregates of organisms be regarded as equipollent or comparable. Then *Lichenes* can hardly be said to hold up its head as a distinct group with the same unimpeachableness that was the case five years ago.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

On the Northern Range of the Fallow Deer in Europe

THE essay, illustrated by woodcuts, on the existence of the Fallow Deer in Pleistocene times in England, in NATURE (vol. xi. p. 210), leaves no room for doubting that the antlers named in the books *Cervus brownii* and *Cervus somonensis*,

really belong to a variety of the living Fallow Deer. And I thank its author, Sir Victor Brooke, for having brought forward evidence on the point which is not presented by any of the vast series of recent antlers known to me in the British and Continental Museums, and without which I could not venture to identify the fossil with the living form. He has supplied the missing link hitherto sought in vain, and thereby removed two synonyms from the bulky catalogue of fossil mammalia. This identification, however, as I have already remarked in NATURE (vol. xi., pp. 113, 114), has little, if anything, to do with the further question, raised by Drs. Jeitteles and Sclater, as to whether the Fallow Deer now living in Northern and Central Europe was introduced—like the horse into South America—by the hand of man; and on this point I am glad to find my views shared by so high an authority on the Cervidæ as Sir Victor Brooke.

W. BOYD DAWKINS

Owens College, Jan. 16

The Habits of the Belted Kingfisher (*Ceryle alcyon*)

IN NATURE, vol. vii. p. 362, I made the assertion that I had "never seen a kingfisher take its food otherwise than by swallowing it whole, while yet upon the wing," and therefore questioned the truth of the remark made by Mr. Darwin, that kingfishers, having caught a fish, "always beat it until it is killed." The truth of my assertion was doubted by many, and being assured by careful observers that Mr. Darwin's remark did apply to our species, I determined to very carefully study the habits of the bird in question, and have taken every opportunity possible, during the past two years, to familiarise myself with the daily routine of its life. The following is the result:—In 1873 my opportunities were exceptionally good for observing the movements of a pair of these birds, inasmuch as the whole season through—from April to November—was spent upon the water, studying our freshwater fishes. My daily record of observations mentions my watching the kingfisher *while feeding*, from one to four times a day for eighty-three days—an average of twice a day, or 166 dives for fishes, witnessed; and either every plunge was unsuccessful, or the bird swallowed, before alighting, every fish he had taken. It is to be presumed, of course, that occasionally the bird missed his prey. At the close of the season, therefore, I felt satisfied that I was correct in my assertions; but, as one of our best ornithologists has said, "the horizon of one man is at the best very limited, and many ornithological facts occur that are not dreamed of in his philosophy;" and so, on mentioning the results of my seven months of observation to a careful observer of our birds, and finding that he sided with Mr. Darwin, I determined to repeat my observations, and have done so through the spring, summer, and early autumn of the present year. My opportunities were equally good, and, very much to my own satisfaction, I have a different result to give. It is proper to state here, that during the summer of 1873 my observations were made altogether in one locality, upon one stream—the summit level of a canal—and confined to one pair of birds. During the present year I watched the kingfishers in several widely differing localities. My note-books make mention of this bird from two to six times in a day, for 101 days—about 400 observations; and of this series, eighty-eight instances are recorded of seeing the kingfisher capture, and, on alighting, deliberately beating the fish against the limb on which he stood, and then swallowing the *butchered* fish. This is a long way from being a constant habit of the kingfisher; less than one-fourth of the fish taken being killed previously to being swallowed. There is, of course, some cause for both habits occurring, and I believe it is to be explained in this way:—

As already stated, my observations during 1873 were confined to one pair of kingfishers, and to the one locality they frequented—the summit level of the Delaware and Raritan Canal—and the obvious reason of the kingfishers always swallowing their prey as soon as caught was simply that they fed exclusively on the smaller cyprinoids frequenting that sheet of water. I know, of my own fishing experience (pursued after a different manner from the kingfishers, however), that millions of cyprinoids are found there, as though they sought there an asylum from the attacks of predatory fishes.

During the season just past, I took notes on such kingfishers as were seen about two creeks, a mill-pond, and the Delaware River. In each of these localities large fishes of many kinds are more or less abundant, and the percentage of small cyprinoids—from two-and-a-half to three inches long—being much less than in the canal, it would evidently be irksome to so voracious a bird as the kingfisher to wait until some fish, the proper size for swallowing without preliminary butchering, should come within reach.

It therefore seems to depend largely upon the size of the captured fish, whether or not it is killed by the kingfisher before being swallowed.

On examination of my note-books I find also that when the parent birds had young in the nest, or while the hen-bird was upon her eggs, the male bird was most frequently seen to carry a fish in his beak to some convenient perch, and there kill and divide it. This appeared to be the manner of proceeding when the parent bird purposed feeding its mate or the young; being able, I judge, to disgorge a fragment of a larger fish, but not to eject an entire fish.

Both habits having been found to be true of this bird—that of swallowing the fish when caught, and of killing it before eating it—it is desirable to know why the latter method should be the rule, almost without exception, in some localities. I can only suggest that this may depend upon the anatomical characteristics of the fishes caught by the kingfishers. When an abundance of cyprinoids—soft-finned fishes—are to be obtained, then little or no preliminary carving on the part of the birds is necessary; but if young acanthopterygians, and tough, hard-scaled fishes of any family, have to be depended upon, then the kingfisher will be careful to first kill and pull in pieces such fishes, that unsuitable portions may be rejected. I have a memorandum of one instance where a young gizzard shad (*Dorosoma cepedianum*) was beheaded and divided into four portions before the kingfisher ate it.

In studying the habits of our American birds—and I suppose it is true of birds everywhere—it must at all times be remembered that there is less stability in the habits of birds than is supposed; and no account of the habits of any one species will exactly detail the various features of its habits as they really are, in every portion of the territory it inhabits.

Trenton, New Jersey, Nov. 20

CHAS. C. ABBOTT

Kirke's Physiology

IN Kirke's "Physiology" (p. 128, 7th edition) mention is made of a conception, due to Mr. Savory, concerning a probable function of the Sinuses of Valsalva, which appears to me to be based on a neglect of an important hydrostatical law. And as this error is not only widely spread, but is considered a point of some importance among students of physiology, it may not perhaps be unwise, even now, to call attention to it. It is stated that, owing to the expansion of the aorta towards its termination, part of the force of the reflux of the column of blood is sustained during diastole by the muscular substance of the ventricle. Now, it seems that a consideration of the law above referred to, which is known as Pascal's "Principle of the Equality of Pressures," must essentially modify this statement. It will be well to note, however, before tracing its application, that notwithstanding the varying mechanical conditions of the column, and the structures in relation with it, these conditions at any one point of time during dilatation may be regarded as fixed and invariable. Also, that as these conditions vary in degree and not in kind, what is true of any one period of time must, in so far as the present demonstration is concerned, be true of any other.

Let us consider the state of things immediately upon the conclusion of the systole. Firstly, the whole arterial system is in a state of distension, and, in virtue of its elasticity, tends to contract and to impel the blood in two directions—onwards through the capillaries, and backwards against the heart. There is also a cessation of the opposing impulsive force from the ventricle, and the combined effect of these two actions is to produce the "force of reflux." And since, as has been shown above, it is unnecessary to trace the variations due to the mobility of the system through the whole period of dilatation, it may be said that at any given instant we have the following data, viz., a column of fluid contained in a vessel with an expanded base, and a certain force impressed upon that column. It is obvious that it cannot affect our conclusions to assume that the force of reflux is transmitted to an imaginary surface, which we can fix at a point immediately above the expansion of the vessel, where it attains its normal calibre, and we can then ascertain how this force is further transmitted to the base. This base is, however, made up of two parts, a circumferential part by the muscular substance of the ventricle, and a central part by the semilunar

valves, the whole area being greater than that of any other section of the column. Now, the question at issue is, whether by this arrangement the semilunar valves bear any less pressure because a portion of the base of the column rests upon the wall of the ventricle. That they do not may be sufficiently proved by the following considerations.

It is a generalisation from Pascal's law that "when a liquid enclosed in a vessel is submitted to an external pressure, every plane surface that we can imagine in the interior of the vessel experiences a pressure proportional to its area." As a consequence of this law, it follows, if the force impressed upon our imaginary surface represent the total force of reflux, that the pressure sustained by the whole area of the base will be considerably greater than the actual force of the column, and this increase of pressure will be proportional to the difference between the areas of the two surfaces. Also, the pressure upon the semilunar valves will be entirely independent of the pressure upon the rest of the base, and will be directly proportional to their own extent. It may be concluded, therefore, that whatever the condition of things at the base of the aorta may be, no mechanical advantage is gained thereby; indeed, if the area of the valves be equal to that of the surface we have taken, they will sustain a pressure equal to the total force of reflux of the column. Hence, by extending the area of the base over the wall of the ventricle, the only effect is to increase the total amount of pressure sustained, without at all lessening the pressure upon its original extent.

It is true that if the aortic orifice contract with the muscular substance of the ventricle, that in this way, *i.e.* by decreasing the area of the valves, a varying amount of advantage would be gained which would be greatest at the time of greatest contraction. This condition is, however, the only one that can at all favour the idea that "the reflux is most efficiently sustained by the muscular substance of the ventricle," and as this condition is doubtful, it must still seem that the main feature of Mr. Savory's theory cannot be supported.

W. PERCY ASHE

Phœnician Characters in Sumatra

IN a short communication to the Anthropological Institute in December last (NATURE, vol. xi. p. 199), Phœnician characters were stated by me to be still in use in South Sumatra. As many of your readers may be glad to have more information on the subject, I write to say that the district above alluded to includes Rejang, Lemba, and Passammah, between the second and fifth parallels of south latitude. Several manuscripts, on bamboo, from this region are preserved in the library of the India Office; and a Rejang alphabet is given by Marsden in his "History of Sumatra," third edition. Some of his characters, however, appear to have been incorrectly copied. About half the Rejang letters are admitted by all the Oriental scholars to whom I have shown them to be Phœnician of the common type; others being similar to forms found in Spain and other Phœnician colonies. Most of the letters are *reversed*, a peculiarity which is explained by the fact that the Rejang writing, according to Marsden, is read from left to right, contrary to the practice of the Malays generally. The matter is of great interest, and, it is to be hoped, will be investigated by Phœnician scholars.

J. PARK HARRISON

Ring Blackbird

IN my letter in NATURE, vol. xi. p. 187, I did not refer to the Ring Ousel, for it did not occur to me that anyone would suppose that, with the apparatus of so many standard works on birds, I could fail to identify my bird, if he were a Ring Ousel, male or female. I therefore add that my bird is in no respect (save the prevailing colour) like that species of *Turdus*. It is *exactly* like a female blackbird, save that it has a white ruff, in the position of the Barbary Dove's ring, and white spot under the chin. I have never seen a Ring Ousel, or the picture of one, with those characteristics. Besides, the Ring Ousel is migratory, and would hardly be seen till the spring.

Athenæum Club, Jan. 16 C. M. INGLEBY

[Considering the time of year at which this specimen was obtained, it is more probable that it is a pied variety of the blackbird (which is far from uncommon) than a Ring Ousel. If our correspondent will forward the specimen to us, for examination, we will settle the point for him, and return it.—ED.]

OUR ASTRONOMICAL COLUMN

THE TOTAL ECLIPSE OF THE SUN ON APRIL 6.—Dr. Janssen's station for the observation of this eclipse is mentioned as probably Hué, the position of which place, as laid down on the Admiralty Chart of Cochin China, is in longitude 107° 38′ east of Greenwich, and latitude 16° 29′ north. For this point the *Nautical Almanac* elements give the following figures:—

First contact at 1h. 38m. 6, local mean time, 130° from the sun's N. point towards the west, for direct image. Totality begins at 2h. 57m. 2s., and continues 3m. 12s., the sun at an altitude of 46°.

ENCKE'S COMET will no doubt be within reach as the moon withdraws from the early evening sky. The positions subjoined are reduced to 8h. Greenwich time from the ephemeris of Dr. von Asten, of Pulkova, published by the Academy of Sciences of St. Petersburg:—

	R.A.	N.P.D.	DISTANCE.
	h. m. s.	° ′	
1875—Jan. 24	23 23 31	85 40·6	1·989
,, 25	— 24 53	85 32·9	
,, 26	— 26 16	85 25·0	
,, 27	— 27 40	85 17·0	
,, 28	— 29 6	85 8·8	1·977
,, 29	— 30 33	85 0·4	
,, 30	— 32 2	84 51·9	
,, 31	— 33 31	84 43·3	
Feb. 1	— 35 2	84 34·5	1·961
,, 2	— 36 34	84 25·5	
,, 3	— 38 8	84 16·4	
,, 4	— 39 43	84 7·1	
,, 5	23 41 20	83 57·6	1·940

Mr. Otto Struve writes that Dr. von Asten's calculations show the last three revolutions of this comet can be perfectly represented by a uniform mean motion, without the hypothesis of a resisting medium, and even with greater precision than all the previous observed returns with that hypothesis. At the same time, during more than one revolution, something like acceleration has been indicated, and nearly to the same amount as Encke had supposed. This was the case between 1862 and 1865. Again, in other revolutions, as between 1845 and 1848, the acceleration has been subjected to very considerable changes. In the actual state of his researches Dr. von Asten is inclined to conclude that the existence of a resisting medium is not proved by the motion of Encke's comet, and that the observed acceleration in several returns ought to be attributed to the action of other forces; for instance, repulsive power produced by the approach of the comet to the sun, the effect of which might vary considerably, according to the conditions in which the return to perihelion takes place. A short paper by Dr. von Asten on this interesting subject is in the press.

WINNECKE'S COMET OF SHORT PERIOD, last visible in 1869, will also be observable in the morning sky from about the next new moon. The ephemeris calculated by Prof. Oppölzer of Vienna will be found in No. 2,016 of the *Astronomische Nachrichten*. This comet will probably be faint, while it remains visible at the present return. It arrives at perihelion on March 12, and at its least distance from the earth on February 15. It is Comet 1819 (3), and Oppölzer thinks he has identified it with one of the imperfectly observed comets in 1808. The elements which have been determined for 1875 show that the comet now makes a very close approach to the orbit of Jupiter; indeed, in heliocentric longitude 109° 25′, the distance between the two orbits is less than 0·06 of the earth's mean distance from the sun; this point is passed rather less than two years before perihelion passage. So far as can be judged at present, the comet will not be liable to great perturbation from the attraction of Jupiter till the year 1907, when it is possible a complete

change of elements may take place; this, however, of course depends upon the amount of change which the actual mean motion may undergo, from the successive smaller perturbations of the next thirty years.

BORRELLY'S COMET OF DECEMBER 6.—Thus far it does not appear that any orbit of the last comet discovered at Marseilles has been published. The following elements, founded on observations between Dec. 7 and 26, received from M. Stephan, Director of that Observatory, may therefore possess some interest:—Perihelion passage, Oct. 19, 1874, at 4h. 36m. Greenwich time; ascending node, 282° 12′ 49″; distance of perihelion from node, counted on the orbit in the direction of motion, 15° 23′ 34″; inclination, 80° 56′ 28″; distance in perihelion, 0·49665; motion, retrograde. These elements bear no close resemblance to those of any previously computed comet.

ON A PROBABLE CAUSE OF THE CHANGE OF THE COURSE OF THE AMÚ DARYA FROM THE CASPIAN TO THE ARAL*

IF the central regions of Asia are really, as is surmised, the localities where the youth of the human race was passed, agriculture, aided by irrigation, has probably been practised from the earliest ages on the banks of the Oxus.

The description, in Herodotus, of the plain in Asia through which a mighty river called Aces ran and watered the lands of five nations inhabiting its banks, may possibly not apply to the Oxus valley, though the Chorasmians are specified as one of the five nations. But the passage clearly describes the distribution of the waters of the Aces for the purposes of cultivation, and it may with reason be inferred that the art of irrigation was in vogue in the Kharesmian oasis some two thousand years ago. However this may be, the Chinese traveller Hiouen-thsang speaks of Khiva, in the seventh century of our era, as forming but a narrow band on both banks of the Oxus; a description which does not admit of a doubt that the waters of the river were then employed in watering the land.

At the present day the Khanate of Khiva, as is well known, owes its fertility to the numerous canals of irrigation derived from the Amú, between Pitnak and Nukus. The heads of these artificial canals are kept open during the part of the year included between the months of May and November, and thus allow the summer or flood waters of the river, which pass into them, to be distributed over the land of the Khanate. As the volumes and velocities of the streams entering the several canals are less than that of the flood of the Amú, a deposition of silt, carried in suspension by the waters, takes place in these canals. For this, among other reasons, their heads are closed during the winter and early spring months, so as to allow of their running dry, and the deposited silt being then cleared, by manual labour, from their beds.

I am not aware that even a rough estimate has ever been made of the quantity of water thus diverted from the Amú, and passing into these canals, during the period of the yearly floods. It is clear, however, that the physical phenomena of the river must be sensibly affected by the abstraction of so large a body of water from its stream, and I will, therefore, make some attempt to arrive at an approximation to the truth on this head, though the data at my disposition are insufficient, and the conditions of the problem are such as render it difficult to attain to any great precision.

The land under cultivation in the Khanate is generally estimated at about two millions of acres; if we assume that the whole of this cultivation requires the constant use of water, about 40,000 cubic feet per second must be taken by the several canals from the river. It is perhaps true that many of the crops do not require more than partial irrigation, but, on the other hand, the population of about 400,000 souls, and the cattle of the Khanate, are entirely dependent on the river for their water supply. The excess, therefore, assigned for irrigation may be considered as absorbed by the people and by the cattle, and the estimate of 40,000 cubic feet per second may be allowed to stand for the present.

* Presented to the Imperial Geographical Society of Russia, December 4, 1874; read at the monthly meeting of the Society, December 16, 1874.

A very rough calculation, founded on the scanty data to be found in General Ivanien's pamphlet on Khiva, and made by me some four months ago, gave 30,000 cubic feet per second as the quantity of water diverted from the Amú by the irrigation canals. It is to be remarked, however, that the few dimensions given of these canals are merely founded on hearsay evidence, and are not the result of actual careful observation, and they refer, moreover, to the state of things which existed forty years ago. No correct estimate can be expected to be deduced from such confessedly general and incomplete information. It results, then, that the first estimate of 40,000 cubic feet per second, founded on the known necessities of the land and its population, is probably nearer the truth than the second, which I derived from a perusal of General Ivanien's interesting pamphlet.

It has already been said that the heads of the canals remain open during the flood season of the Amú; the quantity of water, consequently, entering the canals, depends upon the height of the summer floods of the river, and will be greater as the level of the flood is higher, and will be less as that level is lower. But since a supply of about 40,000 cubic feet per second is a matter of actual necessity to the lives of the population of the Khanate, it is clear that the levels of the canal beds, at their heads, must be so adjusted as to provide for the entry of 40,000 cubic feet per second, even should the level of the Amú flood be an exceptionally low one. It results, therefore, that in all years, except that of an exceptionally low flood, a much greater quantity of water than what is actually required for irrigation and for consumption by the population and by the cattle is diverted from the Amú, and passes by the irrigation canals of Khiva. Ivanien mentions that the excess of water passing by the canals during high floods is allowed to flow into lakes and into the Doudon, Kunya Daryalik, and other old dry beds of the Amú, which thus act as safety-valves to the embankments and works belonging to the irrigated tract. The conclusion which may be drawn from the foregoing is, that in most years there is a very great waste of water arising from the imperfect system of irrigation employed in Khiva. It is needless to enlarge on the magnitude of such an evil in a locality where water is an absolute necessity to prevent the advance of the surrounding desert. With a scientific system of irrigation, it is probable that an acreage of land equal to that at present cultivated on the banks of the Amú might be reclaimed from the desert, by precisely the same expenditure of water which now takes place.

The following table, which I have ventured to compile from the measurements and observations of the Amú Darya made by the officers of the expedition sent in 1874, under the auspices of the Imperial Russian Geographical Society, will enable some idea to be formed of the waste of water which took place on several dates between the 23rd of June and the 10th of September of the year in question. The table shows, in cubic feet per second, the total discharge of the river, the portion of that discharge diverted by the irrigation canals, and the remainder which passed Nukus. I must, however, remark that the quantities shown should be regarded as an approximation only to the truth.

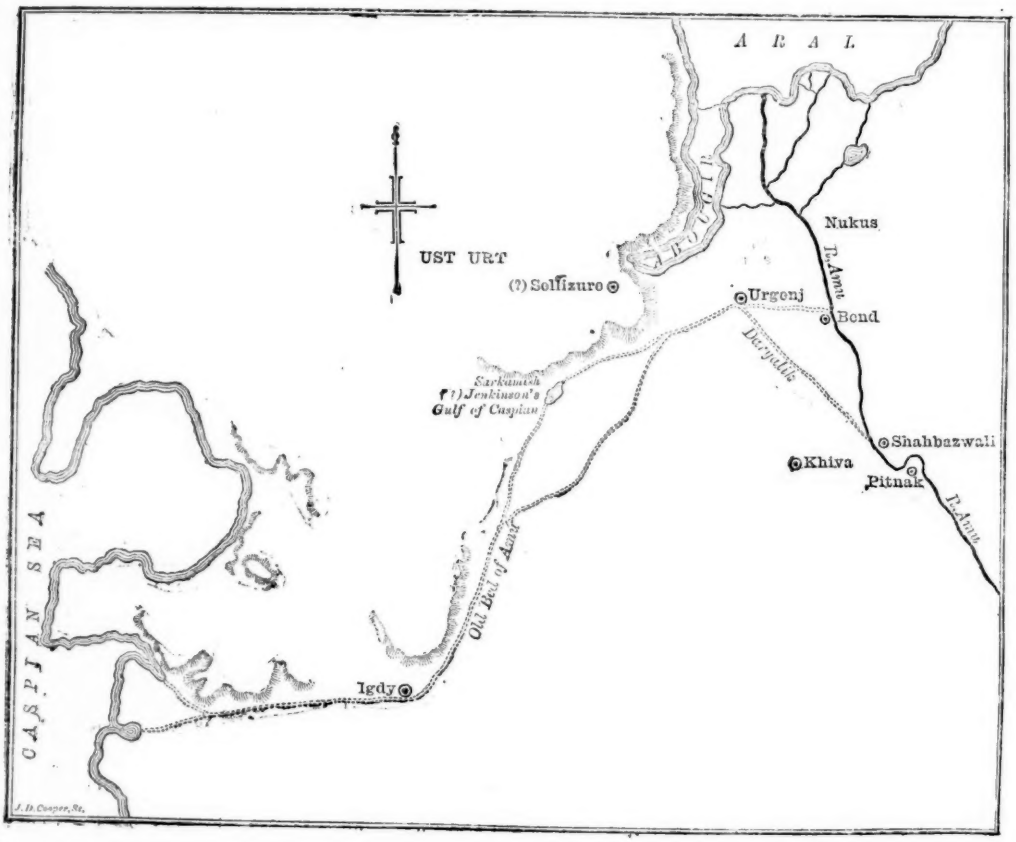
Date. New Style.	Volume of River.	Volume passing Nukus.	Volume entering Canals.
23rd June ...	101,000	47,800	53,200
29th „ ...	97,900	46,300	51,600
11th July ...	139,800	66,200	73,600
17th „ ...	122,600	58,000	64,600
3rd August ...	142,800	67,600	75,200
15th „ ...	120,700	57,200	63,500
25th „ ...	106,000	50,200	55,800
10th September...	93,100	44,100	49,000
Average per diem	122,200	59,600	62,600

These figures show that in lieu of 40,000 cubic feet per second, which is the water supply estimated to be sufficient for the wants of the Khanate, the irrigation canals, between the 23rd of June and the 10th of September, 1874, diverted, on an average, 62,600 cubic feet per second from the Amú Darya, or ten-nineteenths of the whole volume of the river.

Information does not yet exist which would allow more than a guess to be made of the volume of the low-water discharge of the Amú, but from what has been already stated, it follows that at Nukus there is a very much less difference between the

volumes of the summer and winter discharges than there would be if the river were in a state of nature, and if a large portion of its flood-water were not diverted by man for the purposes of irrigation. This equalisation between the summer and winter discharges of the Amú, below the irrigated tract, has great significance, and has suggested to me a cause which may probably account for the change in the course of the river from the Caspian to the Aral. It is a matter of notoriety that the waters of the Amú carry in suspension an enormous quantity of mud and sand, and it is to the deposition, in its old bed, of this suspended matter, that I am inclined to think the change in the course of the river may with much probability be ascribed.

In speaking of the aqueous causes of the changes taking place on the surface of the earth, Sir Charles Lyell, in his "Principles of Geology," has made the following remarks on the transporting power of water. As they cannot be put in plainer and better language, and as they bear intimately on the theory I have hazarded, I will quote them verbatim and *in extenso*:—"The force," he says, "of mountain torrents is easily understood; but a question naturally arises, how the more tranquil rivers of the valleys and plains, flowing on comparatively level ground, can remove the prodigious burden which is discharged into them by their numerous tributaries, and by what means they are enabled to convey the whole mass to the sea. If they had not this removing power, their channels would be annually choked up, and the valleys of the lower country and plains at the base of mountain chains would be continually strewed over with fragments of rock and sterile sand. But this evil is prevented by a general law regulating the conduct of running water: thus, two equal streams do not, when united, occupy a bed of double sur-



face. Nay, the width of the principal river, after the junction of a tributary, sometimes remains the same as before, or is even lessened. The cause of this apparent paradox was long ago explained by the Italian writers, who had studied the confluence of the Po and its feeders in the plains of Lombardy. The addition of a smaller river augments the velocity of the main stream often in the same proportion as it does the quantity of water. The cause of the greater velocity is, firstly, that after the union of two rivers, the water, in place of the friction of four shores, has only that of two to surmount; secondly, because the main body of the stream, being further distant from the banks, flows on with less interruption; and lastly, because a greater quantity of water, moving more swiftly, digs deeper into the river's bed. By this beautiful adjustment the water which drains the interior country is made continually to occupy less room as it approaches the sea, and thus the most valuable part of our continents, the rich deltas and great alluvial plains, are prevented from being constantly under water."

Now, if we apply these principles to the Amú Darya, it is manifest that, when it fell into the Caspian, the conditions of its flow were such that the volume and velocity of its summer or flood-stream were sufficiently great to clear its bed annually of the deposition of silt due to the smaller volume and velocity of its winter stream. The figures given in the table show that the volume of water passing Nukus on the 10th of September was a little more than one-third only of the total discharge of the river on the 3rd of August, on which date, it is probable, the Amú Darya reached its maximum height for 1874. I am inclined to think, from a consideration of the winter discharges which are recorded by Wood in his work on the Upper Oxus,

that the minimum volume of water passing Nukus during the winter months of any year is not very much less than that which passed the same point on the 10th September, 1874. However, it is impossible, in the present state of our information, to state with precision either the volume of discharge during the winter months, or the quantity of water required to pass during the summer, to scour out the deposits made in the bed of the Amú by the winter discharge. But those who are inclined to confide in the intelligent arrangements of nature, will have no difficulty in believing that these two volumes were in such a state of proportion as corrected the evils induced in the bed of the river by the low velocity of the smaller of the two volumes, *i.e.* of the winter discharge of the Amú. Under such circumstances, the bed of the river would be undeteriorated, its course would remain constant, and its flow would continue into the Caspian Sea.

But immediately the volume and velocity of the summer or flood discharges of the Amú Darya were decreased by the action of defluent canals excavated for the irrigation of the lands of Khiva, the compensatory arrangements of nature, which previously kept the river's bed clear, would be interfered with, and some portion of the silt deposited by the winter stream would remain unremoved. This evil would increase yearly, and the intensity of its action would be greater as the quantity of water diverted for irrigation purposes became greater. A portion of the deposit might occasionally be removed by an accidentally high flood, but, eventually, a state of things would supervene in which the conditions of the Amú would present the precise converse of the state of adjustment described in Sir Charles Lyell's work; that is to say, bars and banks of sand would form in the course of the river, would be enlarged yearly, and would prevent it from flowing on to the Caspian. The most westerly point reached by the waters of the river would continually recede to the east, and they would become erratic while seeking an outlet by a slope steeper than that of their encumbered old bed.

Such is a tolerably concise description of what I conceive has actually occurred in the case of the Amú, and has caused the change of its flow into the Aral Sea; and it now remains to examine whether such facts as are known regarding the change and the existent state of things are in harmony with the theory I have ventured to hazard.

Abulgazee Khan, in his history of the Mogols and the Tartars, relates that in the early part of the sixteenth century "all the road from Urgenj as far as Abul Khan was covered with aouls, *i.e.* encampments of nomads; for the Amú Darya, after having passed under the walls of Urgenj, flowed to the foot of the eastern slope of Mount Abul Khan, whence the river turned to the south-west, to turn afterwards to the west, and empty itself at Ogourtcha into the Sea of Mazanderan. The two banks of the river as far as Ogourtcha presented a succession of cultivated lands, of vineyards and of orchards . . . All that country was at that time very populous and in the most flourishing condition." In the early part of the sixteenth century, therefore, the Amú Darya fell into the Caspian, and irrigation, by means of its waters, was general along its banks from Urgenj as far as Abul Khan.

Anthony Jenkinson, the Englishman travelling from the Caspian eastwards in A.D. 1559, arrived on the 5th October at what he called a "gulfe of the Caspian Sea." Here he found "the water very fresh and sweete." He continues: "Note that in times past there did fal into this gulfe the great river Oxus, which hath his springs in the mountains of Parapomisus, in India, and now cometh not so far, but falleth into another river called Ardok, which runneth towards the north. . . ." The "very fresh and sweete water" found by Jenkinson could only have been brought by a flood, or have forced its way either by a channel or by filtration through the sand-banks into the old bed of the Oxus to the spot in question. At the date mentioned, therefore, by Jenkinson, some of the waters of the Amú Darya could still find their way to the Caspian, and the opening of the new course into Ardok, and the closing of the old course, must have been circumstances of tolerably recent occurrence.

Jenkinson continues his narrative thus:—"We, having refreshed ourselves at the forsaid gulfe, departed thence the 4 day of October (either this or his first date, therefore, is a mistake), and the seventh day arrived at a Castle called Sellizure. . . . The Castle of Sellizure is situated upon a high hill. . . . The south part of this Castle is lower land, but very fruitful, where grow many good fruites . . . the water that serveth all that country is drawen by ditches out of the river Oxus, unto the great distruction of the said river, for which cause it falleth not into the Caspian Sea as it hath done in times past, and in short time, all that land is like to be distroied, and to become a wilderness for want of water, when the river of Oxus shall fail."

This apprehension was soon to be realised, for Abulgazee relates, in the work already quoted from, that thirty years before his birth, *i.e.* in A.D. 1575, the Amú Darya found a passage for itself into the Sea of Aral; a circumstance which changed the environs of Urgenj into a desert by depriving them of the water necessary for the irrigation of the soil.

From the foregoing extracts we learn that, commencing with some year early in the sixteenth century, the stream of the Amú Darya, year after year, fell short of reaching as far to the west as it formerly did, until in A.D 1575 the new channel into the Aral conveyed the whole of the waters which remained after the irrigation of the lands of the Khanate lying on the course of the river above Urgenj had been provided for.

As regards the actual condition of the old and present beds of the Amú Darya, the levelling operations carried out in 1873 and 1874 afford the following data:—

Height of Aral	. .	above Caspian	250	feet.	
,,	Igdy . .	,, Caspian	190	,,	
,,	Nukus . .	,, Aral .	60	,,	
,,	Nukus . .	,, Caspian	310	,,	
,,	Bend . .	,, Aral .	70	,,	
,,	Bend . .	,, Caspian	320	,,	
,,	Shahbazwali	,, Aral .	140	,,	
,,	Shahbazwali	,, Caspian	390	,,	
Distance along old Amú from Caspian to Igdy		. .	200	miles.	
,, ,, ,,		Urgenj ,, Igdy . .	274	,,	
,, ,, ,,		Urgenj ,, Bend . .	43	,,	
,, ,, ,,		Urgenj ,, Shahbazwali	133	,,	
,, ,, ,,		Bend . ,, Nukus .	17	,,	

The foregoing distances are taken along the meanders of the bed.

				Inches.
Hence the slope per mile from the		Caspian . to	Igdy . is	11½
,, ,, ,,		Urgenj . ,,	Igdy . ,,	3¾
,, ,, ,,		Bend . . ,,	Urgenj ,,	3¾
,, ,, ,,		Shahbazwali ,,	Urgenj ,,	8½
,, ,, ,,		Shahbazwali ,,	Bend ,,	9¼
,, ,, ,,		Bend . . ,,	Nukus ,,	7¼

From the foregoing I infer Urgenj to be 56½ ft. above Aral, and 306½ ft. above the Caspian.

The following are the conclusions I draw from the foregoing data:—

1. That the old bed between Urgenj and Igdy, having the abnormally small slope of 3¾ in. per mile, has probably been raised by the deposit of silt carried by the waters of the river.

2. That the bed of the Kunya Daryalik, which commences opposite Shahbazwali, having a slope of 8½ in. per mile above Urgenj, discharged a larger body of water than the bed below that place. The difference of the discharges must have been disposed of in irrigation, and the abstraction of water from the Kunya Daryalik was the cause of the silt deposited in the bed of the river below Urgenj, as well as of that in the Kunya Daryalik itself.

3. The bed of Kunya Daryalik having a slope of 8½ in. per mile, while that of the present river, downwards to Bend, from the head of the Kunya Daryalik, has a slope of 9¼ in., it follows, that the slope of the old course must have been flattened from something steeper than 9¼ in. per mile to 8½ in. per mile; otherwise, the waters of the river could have never passed by the Kunya Daryalik towards Urgenj.

4. The water passing along the old Amú being headed back by the deposition of silt in the old bed of the river, became erratic during floods, and found an outlet by the Ardok channel, which eventually carried all the waters of the Amú Darya towards Nukus.

5. The small difference of slope per mile of the beds of the Kunya Daryalik, and the present Amú Darya, explains the tendency of the flood waters to escape from the river, and the necessity of the dams found along the old course. And since the slope of the bed of the Amú Darya down to Bend is 9¼ in. per mile, while that from Bend to Nukus is 7¼, there must always be a tendency, during floods, for the waters to be headed back at Bend, and so to seek an escape by the Loudon channel, across the mouth of which a dam has been constructed to prevent such an occurrence. The condition of the bed of the Amú Darya, from where the irrigation canals commence, down to Bend, fully accords with the theory of the change of the course of the river developed in this note. Descending from the point indicated, the bed of the river is more and more encumbered

with shoals, until in the reach where Bend is situated, and where the maximum volume has been abstracted for purposes of irrigation, the entire breadth of the Amú Darya is obstructed by a mass of sandbanks intersected by narrow and tortuous channels.

It appears, then, that such information as we have, regarding the change and the existent conditions of the old and new courses of the Amú Darya, presents a picture precisely the converse of that delineated in and quoted from Sir Charles Lyell's work. In lieu of a constant increase to the transporting capacity of the waters of the river, we see that in the Amú Darya such is replaced by a constantly diminishing transporting power, and that the old bed has been filled up and destroyed by the deposition of silt. This deposition of silt and deterioration of the bed can only have been caused by the abstraction of its waters for irrigation. Whether other circumstances assisted the consequent change of the flow of the Amú Darya is a question it is not my purpose to examine in this place. Enough has, I would submit, been adduced to show that the practice of irrigation, as conducted on the banks of the Amú Darya, produces phenomena whose action furnishes a probable explanation of a very curious and interesting geographical problem. HERBERT WOOD

THE PARIS INTERNATIONAL CONGRESS OF GEOGRAPHICAL SCIENCE

THE meeting of the International Congress, of which we published the programme a few months ago (vol. x. p. 267), has been postponed, owing to the large number of demands from foreign parts for room in the Exhibition. It will not take place in the beginning of spring as intended orginally, but will be opened on the 1st of August, perhaps by the President of the Republic, who seems to be deeply interested in the success of the enterprise. It will be held in the Pavillon de Flore. This magnificent building was left unfinished when the Empire was upset, and could not be burned by the Communists, as the woodwork had not been begun. It is now being decorated most tastefully, and will be inaugurated by the Congressionists.

An exhibition will also take place in the Pavillon de Flore and Orangerie situated close to the Place de la Concorde. All the Terrace du Bord de l'Eau, from the Pavillon de Flore to the Orangerie, will form part of the Exhibition. Temporary sheds of every description will be constructed in that splendid situation along the banks of the Seine and under the four rows of lofty trees. The *coup d'œil* will be splendid, and is sure to attract an immense number of spectators. The Exhibition will be opened on the 19th of July, and will last until the 4th of August. A very large number of gentlemen of all countries have been appointed members of the honorary committee. The president of the Congress is M. Delesse, a French engineer in the mining service, and a great geologist. M. Delesse is now the president of the Central Committee of the Geographical Society. Up to the present moment the vice-president has not been elected.

The Exhibition and Congress, as we formerly notified, have been divided into seven different groups: (1) Mathematical; (2) Hydrographical; (3) Physical; (4) Historical; (5) Economical; (6) Didactic; (7) Travels.

A programme of 123 questions has been published, and all these, as far as possible, will be discussed by the members of the Congress. The principal questions will be found in the article referred to.

ON THE ALTERATION OF THE NOTE OF RAILWAY WHISTLES IN TRAINS MEETING EACH OTHER

I AM not aware whether the following explanation of this curious acoustical phenomenon has ever appeared in print; if it has, it will, I think, bear repetition, as offering an interesting illustration of some of the laws of propagation of undulations through aërial media.

If two railway trains meet and pass each other at tolerable speed, and the driver of one of them is sounding his whistle, any person in the other train accustomed to music will notice that the moment the whistle passes him its note will be *lowered in pitch* in a marked degree.

It was at first supposed that, at the time of passing, the driver lowered his whistle intentionally, as a salute to the other train (like "dipping the ensign" at sea), but this was found not to be the fact, the driver himself being unconscious of any change. I believe the true explanation was first given by Mr. Scott Russell, but I do not know when or where.

It is an exactly parallel case to one which has recently attracted attention in astronomy, namely, the evidence afforded by the change in position of certain spectral lines, owing to the vapours which produce them approaching or receding from the observer. The explanation of this will be familiar to most of the readers of NATURE, and I have only to apply it to the case in question.

Every musical note propagates aërial waves succeeding each other with a known rapidity, corresponding to the pitch of the note; the higher the pitch, the greater the rapidity of succession of the waves, and *vice versâ*. Now, when a person advances to meet these waves, more of them will pass him in a given time than if he stood still, on the same principle that if a man meets a file of soldiers on march, more men will pass him per minute than if he were stationary. Thus the apparently increased rapidity of the waves will give him the impression of a *sharper* note.

On the other hand, when the trains have passed each other, the listener will be moving in the same direction as the sound-waves, and consequently a *less* number will pass him in a given time, causing the note to appear *flatter*.

The sum of these effects will be the sudden *drop* of the pitch of the note at the moment the listener passes the whistle.

We may reduce the effect to numerical calculation, premising that, in order to simplify the reasoning, we will suppose the source of the sound to be stationary, and the observer to move towards it with a given velocity.

Let n = number of sound-waves propagated by the given note per second; and let n_1 = the number which the listener will gain by his advance in the same time, which is the number he would pass *by his own proper motion* if the waves were standing still.

Then the effective number of waves per second which will meet his ear will be $= n + n_1$, this number determining the pitch of the note he hears. This may be called (by an astronomical analogy) the *apparent* pitch, as distinguished from the *true* pitch.

To find the value of n_1, let L = the *length* of the sound-wave $\left(= \frac{V}{n}\right.$ where V = velocity of sound in feet per second). Then, if v = velocity of motion of the listener he would pass, by his own proper motion, $\frac{v}{L}$ waves per second; whence $n_1 = \frac{v}{L} = \frac{n\,v}{V}$.

Hence the apparent pitch of the note is what will correspond to the number of vibrations

$$= n + \frac{n\,v}{V} = n\left(1 + \frac{v}{V}\right).$$

But we may simplify this by applying the harmonic principle, that a musical interval is measured by the ratio of the vibration numbers of its higher and lower limiting sounds. Let therefore δ = the interval between the real and the apparent sound; then

$$\delta = \frac{n\left(1 + \frac{v}{V}\right)}{n}$$

or $$\delta = 1 + \frac{v}{V} \quad \text{or} \quad = \frac{V+v}{V}$$

A very simple formula, in which the original number of waves disappears, showing that the interval between the two notes is irrespective of the original pitch of the whistle, and depends only on the velocity with which the listener approaches the source of the sound.

We have now to take the case where the listener, having passed the whistle, is receding from the source of sound. The note will then appear flatter than the real one, and its vibration number will be found by the same rule as before, merely giving v a minus sign.

$$= n\left(1 - \frac{v}{V}\right)$$

And the *interval*, i.e., the ratio of the vibrations of the higher to that of the lower, denoted by δ_1 will be

$$\delta_1 = \frac{n}{n\left(1 - \frac{v}{V}\right)} = \frac{V}{V - v}$$

These two intervals added together will express the *drop* of pitch of the whistle at the time of passing.

But to add intervals together we must multiply their ratios; hence if δ_2 represent the drop,

$$\delta_2 = \frac{V+v}{V-v}$$

from which the drop of the whistle corresponding to any speed may be found.

To simplify the reasoning, we have supposed the whistle to be stationary and the listener to move with a velocity $= v$. If both move, as is the usual case in railway trains meeting, v must be made = the sum of the speed of the two.

Taking $V = 1120$ feet per second for ordinary conditions, the following table shows the value of the *drop* for different speeds :—

Conjoint speed of the two meeting trains.			Corresponding drop of the note of the whistle.
Miles per hour.		Feet per second.	
24	...	34	A semitone $\left(\frac{16}{15}\right)$
45	...	66	A whole tone $\left(\frac{9}{8}\right)$
70	...	102	A minor third $\left(\frac{6}{5}\right)$
85	...	125	A major third $\left(\frac{5}{4}\right)$
108	...	160	A fourth $\left(\frac{4}{3}\right)$
152	...	224	A fifth $\left(\frac{3}{2}\right)$

I have made observations whenever I have had the opportunity, and find the results corroborate the deductions of theory. The most common interval observed in ordinary travelling is about a third, major or minor, corresponding to a speed of between thirty-five and forty miles per hour for each train. W. POLE

GLASGOW SCIENCE LECTURES

UNDER the title of the Glasgow Science Lectures Association, an organisation has lately been formed in Glasgow, whose object is to provide annual courses of lectures on various branches of science by men of eminence in each department, so as to place in clear and comprehensive outlines the most important results of scientific inquiry before the public of Glasgow, and at such a rate as will secure to those who cannot otherwise obtain it the best information on the state of science, as established by the most recent investigations of its most distinguished workers. The scheme originated amongst a number of working men who were desirous of following the example of the science lecture movement which has been so successfully worked out in Manchester during the last six or seven years, but with this difference, namely, that the lectures should be self-supporting. To accomplish that end, and be in a position to pay the lecturers liberally for their services, they at once saw that the minimum rate of admission could not well be fixed at less than threepence, and they confidently believed that many of their fellows would be most willing to pay that amount for the privilege which it was proposed to place within their reach. They soon enlisted the sympathies and active co-operation of persons in a higher social sphere, and in due time the Association took active shape. A large executive committee was constituted, and Dr. Allen Thomson, F.R.S., one of the most distinguished members of the professorial staff of the University of Glasgow, cheerfully accepted the honorary presidentship of the Association, while a number of other prominent citizens were enrolled in the list of vice-presidents.

Owing to the fact that Prof. Roscoe had been the moving spirit of the Manchester Science Lectures for the People, he was very early communicated with, in the confident hope that valuable advice based upon his practical experience would readily be placed at the service of the originators of the Glasgow lecture scheme. They were not disappointed in their expectations, and, indeed, had they been lacking in enthusiasm and determination to make the scheme a success, they would have been stimulated to action by the various communications which they received from that gentleman.

It was very late in the past year before the Glasgow Science Lectures Association was sufficiently well organised to make any public announcement of its existence; but the active promoters of the movement were most anxious not to allow the whole winter to pass without having some lectures delivered under the auspices of the Association, no matter how short the course might be. Prof. Roscoe most kindly and cheerfully consented to take part in the first or introductory course; and considering that gentleman's peculiar relationship to the Manchester Science Lectures, the committee came to the conclusion that no person could more appropriately assist at the public inauguration of the movement in Glasgow. Accordingly, with his consent, Prof. Roscoe was set down to deliver the opening lecture of the introductory course, and other three distinguished men of science were selected to follow him, namely, Sir William Thomson, Dr. W. B. Carpenter, and Prof. W. C. Williamson, of Owens College, Manchester.

The inaugural lecture was delivered on the evening of Friday, the 8th of January, and it was in every sense a most auspicious beginning. The Glasgow City Hall was chosen as the place for the delivery of the lectures, as the committee were desirous of bringing together the largest audiences that could be convened in any place of public meeting. It holds well-nigh three thousand persons, and on the occasion in question it was crowded. The reception given to the eminent lecturer was most enthusiastic. Dr. Thomson occupied the chair, and in introducing Prof. Roscoe to the meeting and formally opening the first course of lectures, he delivered an exceedingly valuable address, in the course of which he justified the formation of such associations as the one under whose auspices the lectures were to be given. He said that he had no doubt that in the selection of the lecturers the committee of the

Association would always keep in view the possession by the lecturers of those qualities which alone could secure ultimate success in their enterprise, and which might be summed up as follows :—First, the fulness of knowledge which belongs to an accomplished master of his subject ; second, the authority in statement which is derived from original research ; and third, the disposition and power to convey full and accurate information to others with simplicity and clearness.

The subject of Prof. Roscoe's lecture was "The History of the Chemical Elements," and it was most completely and successfully illustrated, especially in the department of spectrum analysis.

Sir William Thomson's lecture will be on "The Tides," in which it is expected that a full exposition will be given of the more important results arrived at by the British Association Tidal Committee in their recent investigations.

Dr. Carpenter has chosen as his subject "Man not an Automaton," with reference to the recent lectures of Professors Huxley and Clifford ; and the concluding lecture, by Prof. W. C. Williamson, will be on "The Dawn of Animal Life."

It is the intention of the committee in future sessions to provide courses of eight or ten lectures, embracing all those branches of science that are susceptible of being treated thoroughly before large and miscellaneous audiences. What the public now want is lectures of the highest class, conveying ample information, but without unnecessary technicality and learned difficulty. The success of the Manchester Science Lectures for the People and of the lectures delivered to the working men in the towns visited by the British Association during recent years, abundantly shows that such a desire is yearly becoming more and more prevalent. JOHN MAYER

ATLANTIC NOTES

Migration of Birds—The Thresher and Whale

IN crossing the Atlantic last September, when 900 miles distant from the nearest point of Newfoundland, two land birds settled on the ship, and after a short rest resumed their flight to the south-east, without partaking of the food which was scattered in various places for them. By the colour of their plumage and motion on the wing, I believe them to be a species of lark. It may well be asked whence did they come, and whither were they going over that vast space of ocean, with no resting-place nearer the continent than the Azores? How were they fed during their long journey, and what guided them on their course? for it is only reasonable to suppose they had come on a bee line from their starting point, and even then their muscular powers must have been severely taxed. It appears to me that naturalists are not in possession of the secret which enables birds of passage to go many days without food at a time when their system must be strained to its extreme limit of endurance.

From the result of close observation, I do not believe that land birds are often, if ever, driven to sea by the force of the wind. Some other cause must influence their movements. At the head of the Gulf of Bothnia, when there has not been a storm for many days, I have seen scores of different species around the ship, amongst them the hawk, the owl, the robin, and many others. Are those who alight and stay by the ship the stragglers from the ranks of the armies which annually migrate, the sick and worn who fall out by the roadside to die, whose end in creation has been fulfilled, and their places ready to be taken by the young and strong? This surmise is strengthened by the fact that no care can preserve the lives of these tired birds in captivity ; the hawk and dove alike refuse food, and quickly pine and die.

Birds must possess strong affections, as they are always seen in pairs on these long journeys, which is an additional argument in favour of their voluntary flight over the ocean. It is scarcely possible they could remain together in a gale sufficiently powerful to blow them off the land, and more unreasonable still to imagine that the strength which is able to carry them hundreds of miles without a rest should fail to breast an ordinary gale under the shelter of the land. Such facts as these vouch for the facility with which the most remote islands may increase the number of their species without the agency of man.

Off Youghal a gigantic thresher (*Squalus vulpecula*) was passed. It was leaping lazily and obliquely from the water, and after attaining its highest altitude, fell heavily on the surface, without making any effort to ease or guide its descent. This fish was not under fourteen feet in length ; the belly of a pearly whiteness, and the back marked across with broad black bands. I have never seen this fish north before ; but on the whaling grounds of the southern seas it is common. I do not believe it is dangerous to the life of the whale, as is often stated, but am under the impression that the irritation caused by the attacks of the thresher makes the animal vomit up the squid and other small matter on which it feeds. It is not reasonable to suppose that the blows inflicted by so small an instrument as the thresher's tail can have much effect through a foot of blubber. The whale has also many ways of escaping from its puny enemy ; he dives to a depth where the thresher cannot follow, and if he could, his power of inflicting injury would be gone, owing to the resistance caused by the water ; his speed also enables him to escape at all times. The treaty of offence which is said to exist between the thresher and sword-fish appears to me to be very mythical. When the whale is sick or dying, he is doubtless an object of attack to all the shark species, as they wage war with the whaler for the coveted blubber. WM. W. KIDDLE

THE TRANSIT OF VENUS

THE *Times* of yesterday contains some additional news from the Transit parties, specially those of France and Italy.

The French news consists of telegrams from Shanghai in the Northern and from New Caledonia in the Southern Hemisphere. From the former station M. Fleuriais, the astronomer in charge at Pekin, now states that he was fortunate enough to observe all the four contacts, and not two only, as was at first stated. The times were as follows in local mean time :—First contact, 21h. 32m. 42s. ; second, 22h. ; third, 1h. 50m. 15s. ; fourth, 2h. 17m. 13s. Nor is this all ; no less than sixty photographs were taken which M. Fleuriais pronounces good. We have already stated that stations in Northern China are most useful for the application of the Halleyan and direct methods. From New Caledonia the best part of the news refers to the photographic operations, 100 good photographs being secured. Of the contacts, only the interior one at ingress was observed.

The news of the doings of the Italians comes from the party in Bengal, in charge of the distinguished spectroscopist Tacchini, including Dorna, Lafont, Morso, Abetti, and Tacchini. The telegram comes from Maddapore, and the party evidently occupied two stations. The first three observed all four contacts, the last two only the third and fourth.

As before stated, the chief instrument employed by the Italians was the spectroscope—an instrument not recognised in the equipment of any of the English parties.

The observations were of the most satisfactory kind, and the results may lead to a most important discovery in solar physics. The time of interior contact at egress was observed with the most rigorous exactness, both by the

ordinary telescopic method and by the spectroscopic method described in our former notes. It was found that the difference between the times of observation by these methods *was more than two minutes*, contact being observed by the spectroscope first. Now, if the contact had been observed last by the spectroscope, there was an obvious condition of the observation to which the disaccord might have been attributed; but there is now no room for doubt that the sun's extreme edge which we actually see in a telescope differs physically from the part just within it, although there is no difference to the eye—in fact, that it gives a spectrum of bright lines, while the spectrum of the true subjacent sun gives a continuous spectrum with dark lines. Further, the physical difference to which we refer would probably tend to make this stratum variable in thickness and luminosity. Nay, we may already hazard the question whether there is not here a condition which may have something to do with the various times of contact recorded by observers having object-glasses widely differing either in aperture or in the over- or under-correction of the chromatic dispersion.

Another victory achieved by the Italians is the determination of the nature of the atmosphere of Venus. The ring round the planet, which in the former transits as in the present one was visible round Venus both on and off the sun, indicates in the spectroscrope that in that planet, as in our own, the atmosphere is composed to a certain extent of aqueous vapour.

Mr. Proctor pointed out some time ago the great value of photographs taken at the Cape of Good Hope in combination with those secured at Nertschinsk and Roorkee. We have no information that any photographs were taken at the Royal Observatory at Cape Town, but a correspondent informs us that fourteen successful photographs were taken at Cape Town, two of them showing distinctly the black drop.

The *Times* then refers to the final appendices to the "Recueil de Memoires, Rapports et Documents relatifs à l'observation du Passage de Venus sur le Soleil," as enabling us at length to refer to the doings of the Commission appointed by the French Government. The records extend from February 1869, when the Government first moved in the matter, to a few months ago, when the final instructions on the methods to be adopted to guard the observations against risk of loss were issued.

The first action of the French Government was to ask the Academy of Sciences to consider the places to be occupied, and the number of observers; the instruments to be used; the additional researches which might be undertaken by the observers sent to the Southern Hemisphere; and, finally, whether an Astronomical Congress would not be desirable to bring about a uniform system of observations.

A strong commission was at once appointed, composed of mathematicians, astronomers, physicists, and chemists, in order that the problem might be considered in an efficient manner. Strangely enough, the name of M. Leverrier, the distinguished Director of the Paris Observatory, does not appear on the commission; he did not think the observations of the Transit necessary to prove the accuracy of his values of the solar parallax. Happily, his voice was overruled. The course taken, as the *Times* remarks, suggests how desirable some similar procedure here would have been.

"There are very many points of the greatest interest," the *Times* continues, "raised by the contents of this large volume to which we should refer did space permit; from beginning to end it shows how a nation should set itself to work—how all the intellect of a nation can and must be utilised, when a great problem involving many kinds of special knowledge has to be attacked. It is often said that in France science is crushed by a dead weight of officialism, and that in England it is free. However true this may be of teaching, there is ample evidence in this volume that, in one branch of research at least, the very opposite of this statement is much nearer the truth, and the painful discussions which some time ago occurred in our own columns and elsewhere, the 'Appeals to America,' the action of the Board of Visitors of the Greenwich Observatory, and the like, afford a strong argument—if, indeed, one were needed—that the growth of science necessitates that in all future national enterprises of the kind the example of the French and of all the other Governments should be followed. In this way only, in our opinion, can the national scientific honour be upheld, while the officials concerned in carrying out the work would be strengthened in their positions and shielded from a responsibility too great for individuals to bear."

NOTES

THE arrangements for securing observations of the Solar Eclipse of April 6 are progressing most satisfactorily, thanks to the energy of the Royal Society Committee and the varied knowledge that has been brought to bear upon the various points of attack. Lord Salisbury has brought the proposed action of the Royal Society before the Council of India, and such instructions have already been telegraphed to India as will probably result in this eclipse being observed with a wealth of observers and instrumental appliances beyond all precedent.

CAPTAIN NARES, who is to command the English Arctic Expedition, has arrived in London. Commander Markham returned on Saturday from Dundee, after having entered six good men, tried seal and whale fishers, as ice-quartermasters. Staff-Surgeon Thomas Colan, M.D., of the *Unicorn*, drill-ship of the Naval Reserve at Dundee, has been selected by the Admiralty as senior medical officer of the Expedition. With regard to the proposed German Expedition, the desire is, we believe, if the funds can be raised, to form a scheme of co-operation between the two exploring expeditions. Surely our brother Teutons, richer now than ever they were, and whose zeal for knowledge is proverbial, will not allow this splendid scheme to be marred for lack of funds.

THE Museum of the Royal College of Surgeons contains a series of casts of the interior of the cranial cavity, representing exactly the form and size of the brain (when covered by its membranes), of men of various races, and of many species of animals. With a view to diffuse the information to be derived from the study of these casts, and believing that many educational institutions will be glad to avail themselves of the opportunity of possessing them, the Council of the College has authorised the issue of copies at the lowest price at which they can be reproduced, which will partly depend upon the number likely to be required. The Conservator of the Museum would like those who desire to possess the whole or part of the series, which comprises many rare forms, to communicate with him on the subject.

AT its *séance* of Jan. 11, the Paris Academy elected a corresponding member in the section of Mechanics, in place of the late M. Burdin. Three candidates were proposed—M. Broch, the Norwegian mathematician, who obtained twenty-four votes; Prof. Stokes, F.R.S., twenty-one votes; and M. Calladon, one vote. Thus M. Broch was elected by only three votes over Prof. Stokes.

MR. SIMON NEWCOMB, the American astronomer, is now in Paris. He has paid a visit to the Observatory, in order to inquire into the possibility of constructing a large refracting telescope having a lens of one metre in diameter. A sum of

30,000*l.* was, as we have already intimated, placed at his command by Mr. Lick, the celebrated Californian capitalist, who is the founder of the Lick Observatory.

M. CHEVREUL, the great French chemist and director of the Jardin des Plantes, has been presented by the Minister of Public Instruction with the grade of Grand Officer in the Legion d'Honneur. This promotion is considered as being a compensation for the difficulties raised by the Ministry in the appointment of a Professor in the Museum. These quarrels had induced the venerable *savant* to resign.

THE *Bulletin* of the French Geographical Society for December contains an exceedingly interesting and carefully compiled paper by M. H. Duveyrier, entitled "L'Afrique Necrologique." This is a list of all the African explorers, from 1800 to 1874, who have met their death while doing their work, either from disease caught in the country, or by murder, or other causes; a very large proportion have died from "intermittent fever." The list includes not only those whose object was purely geographical discovery, but also those whose researches were connected with geology, meteorology, botany, zoology, ethnography, archæology, or languages. The list is a sadly long one, numbering about 150; and M. Duveyrier, in each case, gives a brief account of the explorer and of the work which he accomplished; a large proportion of these martyrs to science are English. Accompanying the paper is an ingeniously constructed map, showing the place at which each traveller met his death.

IT is announced that the committee to whose hands the Sub-Wealden Exploration is entrusted have resolved to abandon the present boring after six ineffectual efforts to recover tools which have dropped down and obstructed the whole. The Diamond Boring Company having made a very favourable offer to commence again, a contract for the completion of 1,000 feet for 600*l.* has been agreed to, with a conditional promise to execute the second thousand feet for about 3,000*l.* additional. Mr. Willett, hon. sec., has guaranteed 600*l.*, and appeals for funds to carry on the enterprise.

MR. CHARLES DARWIN'S new work on "Insectivorous and Climbing Plants is in the press and will be shortly published. The following are the contents:—Part I.: On the sensitiveness of the leaves of *Drosera*, *Dionæa*, *Pinguicula*, &c., to certain stimulants; and on their power of digesting and absorbing certain animal matter. Part II.: On the habits and movements of climbing plants. The book will be issued by Mr. John Murray.

MR. JOHN MURRAY has also preparing for publication the following two works in travel:—"The Land of the North Wind," being an account of travels among the Laplanders and Samoyedes, and along the coast of the White Sea, by Edward Rae; this book will be illustrated by a map and woodcuts: and a description of a journey to Tabreez, Kurdistan, down the Tigris and Euphrates to Nineveh and Babylon, and across the desert to Palmyra, by Baron Max von Thielmann. The title of the book will be "The Caucasus, Persia, and Turkey in Asia," and it will be translated from the German by Mr. Charles Heneage.

MESSRS. LONGMAN and Co. have in the press a translation of a work on the Primæval World of Switzerland, by Prof. Oswald Heer, of the University of Zurich. The book will be edited by Mr. James Heywood, M.A., F.R.S., and will be issued in two octavo volumes with numerous illustrations. The same firm will shortly publish a series of Elementary Lessons on the Structure of Man and Animals, with special reference to the principles affecting health, food, and cooking, and the duties of man to the animal creation; by Mrs. Buckton. This volume will be illustrated with wood engravings.

IN the *Astronomische Nachrichten*, Nos. 2,009 and 2,016, are notes on the spectroscopic observation of fifty-two stars made by M. D'Arrest. The stars are chiefly of the 6th and 7th magnitude, and appear in the Bonn Catalogue. The colours of thirty-four of these stars are given, and the type to which each star belongs is generally mentioned. From an analysis of the notes we gain that there are in the list four red or reddish stars of type III. and two of type IV.; of reddish yellow stars there are nine of type III.; of yellow or orange stars there are thirteen of type III., and of the same type one brown and five colourless ones; on the remaining eighteen there are no remarks on colour. The author remarks on the different grades of spectra of type III., from an almost line spectrum to a discontinuous one of bands, as that of α Herculis, but that grades of colour do not always agree with grades of spectrum; and he thinks that the theory that the coloured stars are older because cooler than others cannot be received without numerous exceptions, and he has concluded that the temperature of the coloured stars may in general be lower than that of others, but that it is not proved; and further, that the greater age of these stars is without foundation. The author appears to take exception to the part of the address of M. Wurtz at the French Association, reported in NATURE, vol. x. p. 350, where he says of the stars, "We have classed them according to their ages. Stars coloured, stars yellow, stars white; the white are the hottest and the youngest . . . the coloured stars are not so hot, and are older." It certainly seems from M. D'Arrest's observation that there are exceptions to this rule, and a large number of stars must have their spectra and colours tabulated before it can be judged how far this law holds good.

AT the last meeting of the Photographic Society a paper was read by Mr. Hooper, "On the Origin, Aim, and Achievements of the Photographic Society, with suggestions as to its future development." The suggestions were, the necessity of obtaining a Royal Charter, the Society's claim upon the Government for a money grant and suitable premises, and the necessity of forming committees for scientific investigation. In the subsequent discussion, the general opinion was that there was little hope of obtaining the proposed Charter, and that it was a mistake to speak of photography as a science. "Science," one speaker said, "had done a great deal more for photography than photography had done for science."

AT the meeting of Convocation of the London University on Tuesday, the motion brought forward by Mr. A. P. Hensman, "That, in the opinion of Convocation, it is desirable that women should be permitted to take degrees in Arts in this University," was, after some discussion, withdrawn.

A RECENT decision has been given by the French Ministry in favour of female doctors. A certain Mdlle. Domerque, of Montpellier, has received due authorisation to pass her examination for the doctorship.

WE are glad to see that by the decision of the Supreme Court at Sydney, N.S.W., Mr. Gerard Krefft has been restored to his position and house as Curator of the Sydney Museum. Mr. Krefft has been connected with the Museum for fourteen years, and in September last had been violently ejected by an order from the trustees, who, it seems, had in this exceeded their powers.

THE prospectus lies before us of a new Italian monthly journal, to be entitled, *Rivista Popolare di Scienze e Lettere*. Judging from the prospectus, its projectors have a high idea of the important place which science is daily assuming in the life of the world, and intend to devote a considerable proportion of the pages of their Review to subjects of scientific interest. The programme of the new journal is very comprehensive, embracing all departments of philosophy and physical science, and we most

heartily wish it complete success. The prospectus is dated from Lentini, in Sicily, where, we believe, the Review is to be published. It seems rather strange to make such an out-of-the-way place the head-quarters of so important an undertaking; we hope, however, its circulation won't suffer in consequence.

THERE are many signs that Italy is really awakened from her long dormancy and seems quietly determined to do her share of the modern world's work. The above announcement may be regarded as one, and we know that in more than one of the sciences valuable work is being done by Italians. In geography, especially, they seem inclined to revive the reputation which of old their country had; they have recently produced one or two noteworthy explorers, and their geographical magazine, *Cosmos*, is a model of typography and good editing. Only on Monday last, Prince Humbert, in returning thanks for his election as President of the Italian Geographical Society, spoke with warm approval of the project of an expedition to the African great lakes, and hoped that Italy would be worthily represented at the forthcoming Geographical Congress at Paris.

THE Queensland Government have received information that Hume, who proceeded in search of Classan, a supposed survivor of the Leichardt Exploring Expedition, perished for want of water fifty miles from Drynan's station on the Wilson River, in the Warrego district. O'Hea, another of the party, is also supposed to be dead. The third man, Thompson, has reached Drynan's station.

AS about forty ladies and gentlemen have signified their intenion to become members of the proposed Natural History Society at Watford, a meeting to found the Society and to elect a provisional committee will be held at the Watford Public Library on the 23rd inst., at seven o'clock.

P. W. WRIGHT, one of the late porters at the College of Surgeons Museum, commenced duty as dissecting-room porter at St. Thomas's Hospital about a fortnight ago. On last Tuesday week he wounded himself in the hand with a knife whilst assisting in a post-mortem on a child which had died of pyæmia. We regret to hear that he died in consequence of the wound, from the same disease, on Monday last, leaving a wife and five young children quite unprovided for.

M. J. DEBY, in examining the contents of the stomachs of mussels (*Mytilus edulis*) from the Brussels market, found thirty-seven species of diatoms, including *Hyalodiscus stelliger*, a species found previously only in Florida.

THE death of the veteran Dr. Gideon Lincecum, of Long Point, Texas (U.S.), is announced as having taken place at his residence on the 28th of November last, in his eighty-second year. Dr. Lincecum was well known to the naturalists of the United States on account of his abilities as an observer and the wonderful minuteness of his investigations into the habits and peculiarities of American animals. His contributions in this direction to the archives of the Smithsonian Institution, to the *American Naturalist*, to the Academy of Natural Sciences, and to the *American Sportsman*, were very numerous and varied. In addition to his contributions of notes, Dr. Lincecum was an extensive collector of specimens, especially of insects and reptiles of which he sent large numbers to the museums of the United States.

PROF. MARSH and his exploring party returned to New Haven, U.S., on Dec. 12, after an absence of two months in the Rocky Mountains. The object of the present expedition was to examine a remarkable fossil locality, discovered during the past summer in the "Bad Lands" south of the Black Hills. The explorations were very successful, notwithstanding extremely cold weather and the continued hostility of the Sioux Indians. The fossil deposits explored were mainly of Miocene age, and, although quite limited in extent, proved to be rich beyond expectation. Nearly two tons of fossil bones were collected, most of them rare specimens, and many unknown to science. Among the most interesting remains found were several species of gigantic *Brontotheridæ*, nearly as large as elephants. At one point these bones were heaped together in such numbers as to indicate that the animals lived in herds, and had been washed into this ancient lake by a freshet. Successful explorations were made, also, in the Pliocene strata of the same region. All the collections secured go to Yale College, and will soon be described by Prof. Marsh.

DR. HUNT gives an account, in the Proceedings of the Boston Society of Natural History, of the contents of the stomach of a mastodon lately found in Wayland, New York. These consisted of remains of both cryptogams and flowering plants, exhibiting distinctly the vegetable characters. No sphagnum was found in the deposit. The evidence was that the animal had eaten his last meal from the tender mosses and boughs of the flowering plants growing on the banks of streams and margins of swamps, and that pines and cedars formed no part of his diet.

CARRIER pigeons have been employed for a new purpose. When his Majesty of Spain was nearing Barcelona, a Spanish steamer was sent to meet *Los Navos* on the high seas, and succeeded in doing so at the distance of 150 miles from the seaport. Carrier pigeons were then liberated so as to announce in Barcelona the happy coming of Don Alphonso XII. The experiment appears to have been successful. It is said that carrier pigeons were in use among the old Roman navigators in the time of the Cæsars. The practice was discontinued for centuries, and the question has been asked by some French papers whether it is desirable to revive it for Transatlantic steamers.

THE Signal Service observer on the summit of Pike's Peak (U.S.) reports that the local storms there experienced originate over the parks to the westward on hot afternoons. On one occasion he was favoured with an excellent view of the interior structure of the clouds of a tornado, when he observed that while the cloud-bearing currents of air float toward the centre, they had a decided downward movement, but that masses of smoke-like vapour rapidly ascended through the interior funnel.

IN a paper read by Capt. Shaw, of the Metropolitan Fire Brigade, at the Society of Arts on Tuesday night, an ingenious apparatus was described for enabling persons to breathe in dense smoke or poisonous vapours. It consists essentially of a close-fitting hood, with a respirator, holding a filter, the invention of Prof. Tyndall, which consists of a valve chamber and filter tube about 4 inches long, screwed on outside, with access to it from the inside by a wooden mouth-piece. The charge for the filter consists of the following materials, which are put in with the tube turned upside down, and the lower valve removed:—Half an inch deep of dry cotton-wool, an inch deep of the same wool saturated with glycerine, a thin layer of dry wool, half an inch deep of fragments of charcoal, half an inch deep of dry wool, half an inch deep of fragments of lime, and about an inch of dry wool. The whole can be put on and adjusted in a few seconds by the wearer.

THE additions to the Zoological Society's Gardens during the past week include a Pig-tailed Monkey (*Macacus nemestrinus*) from Java, presented by Dr. Cole; a Crested Porcupine (*Hystrix cristata*) from Mogadore, presented by Mr. Alfred Hay; two Chukar Partridges (*Caccabis chukar*) from North-west India, presented by Capt. Murray; a Sooty Mangabey (*Cercocebus fuliginosus*), and a Patas Monkey (*Cercopithecus ruber*) from West Africa; an Australian Goshawk (*Astur approximans*) from Australia, purchased; an Ocelot (*Felis pardalis*) from America, deposited.

SCIENTIFIC SERIALS

Poggendorff's Annalen der Physik und Chemie, No. 10.—This number contains several papers of great interest: the first is by G. Quincke, on electric currents resulting from the non-simultaneous insertion of two mercury-electrodes into different liquids. The author bases his experiments upon those of St. Claire Deville and Troost, who found it probable that platinum absorbs hydrogen or other gases when being heated in a gas or alcohol flame, and then shows a different electric action towards water and dilute acids from that of platinum that has not been so heated. The paper contains a minute description of the apparatus used and tables of the results obtained; in an appendix the author treats of the relation between capillary and electrical phenomena, referring to G. Lippmann's paper (*Pogg. Ann.*, vol. 149, p. 556), from whom he materially differs.—Experiments made with a magnetised copper wire, by Prof. Balfour Stewart and Dr. A. Schuster.—On the chemical action of the solar spectrum upon haloid salts of silver, by H. W. Vogel. Chloride, bromide, and iodide of silver, are not only sensitive towards the highly refrangible rays of the spectrum, but also towards the less refrangible ones, although in a much smaller degree; their sensitiveness does not only depend upon their optical power of absorption of the respective rays, but also upon the absorption power of other substances they may be mixed with. Coloured substances which assist the photographic reduction process and absorb certain spectral rays, highly increase the sensitiveness of the silver salt towards the absorbed rays; thus the sensitiveness of silver salts for red, yellow, and green rays can be greatly augmented. Certain colourless bodies are found to have a similar action. The light reflected from pigments shows a very different effect from that of spectral colours, on account of the varying optical composition of artificial colours and their smaller intensity.—On the question of velocity of magnetic action at distances, by H. Herwig; investigations relating principally to terrestrial magnetism. It is found that this velocity is at least half a million geographical miles (or about 2½ millions of English miles) per second; in other words, that at any given spot on the surface of the earth terrestrial magnetism becomes fully active in less than the 300th part of a second.—On a modification of the magneto-electric revolution experiment, by the same.—On comparison of electric machines, by Mr. Mascart. The author describes experiments made to ascertain the actual quantity of electricity produced by eleven different machines in a given time and under the same conditions.—On the measuring of the electromotive power of voltaic piles in absolute units, by A. Crova.—The frequency of changes of colour in the scintillation of stars is generally related to the spectrum they show, by C. Montigny. Stars that twinkle strongly show few spectral lines, while those with little scintillation have many bands and lines in their spectra.—On the theory of organ-pipes, by H. Schneebeli.—Is the application of the *vis viva* justified in the mechanical theory of heat? by H. Fritsch. The author answers this question in the negative.—On induction-effects in magnets of different hardness, by L. Külp.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Jan. 7.—"Remarks on a New Map of the Solar Spectrum," by J. Norman Lockyer, F.R.S.

I beg permission to lay before the Royal Society a portion of the new map of the solar spectrum, referred to in one of my former communications.

It consists of the portion between w. l. 39 and 41.

I have found it necessary, in order to include all the lines visible in my photographs in such a manner that coincidences may be clearly shown, to construct it on four times the scale of Angström's "Spectre-Normal."

The spectra of the following elements have been photographed side by side with the solar spectrum, and the coincidences shown:—

Fe, Co, Ni, Mn, Ce, U, Cr, Ba, Sr, Ca, K, Al.

The wave-lengths of new lines in the portion of this spectrum at present completed have been obtained from curves of graphical interpolation. Instead of the reading of a micrometer-scale, a photographic print of the spectrum has been employed in the construction of these curves, the wave-lengths of the principal lines being taken from an unpublished map of the ultra-violet region of the solar spectrum, a copy of which has been kindly placed at my disposal by M. Cornu. The photograph of the solar spectrum, from the ultra-violet to beyond F, kindly given to me by Mr. Rutherford, has also proved of great service in the present work. I have, in fact, up to the present time, only been able to excel this photograph in the region about H.

From the extreme difficulty of carrying on eye-observations upon the portion of the spectrum now completed, Angström's map is, of course, very incomplete about this region. The few lines mapped differ slightly in some cases from the positions assigned by Cornu; but the wave-lengths given by the latter observer generally fall into the curve without breaking its symmetry, and these positions have therefore been adopted. The advantage possessed by the photographic method over eye-observation may be estimated from the following numerical comparisons:—

Region of spectrum, 3900–4100.

Number of lines in	Angström's "Spectre-Normal"	39
" "	Angström's and Thalén's map of the violet part of the solar spectrum ...	185
" "	Cornu's map	205
" "	New Map	518

It will serve further to illustrate the advantages of the photographic method, to compare the number of lines in the spectra of metals already observed with the number of lines of the same metal given by Angström in the "Spectre-Normal."

Region of spectrum, 3900–4100.

Metal.	Lines in new map.	Lines in Thalén's map.
Fe	71	19
Mn	53	12
Co	47	—
Ni	17	—
Ce	163	—
U	18	—
Cr	24	—
Ba	7	—
Sr	5	—
Ca	7	6
K	2	—
Al	2	2
Total ...	416	Total ... 39

The purification of the various metallic spectra has at present been only partially effected; but I have seen enough already to convince me of the extreme rigour with which the principle I have already announced may be applied, while at the same time there are evidences that the application of it may lead to some results not anticipated in the first instance.

My object in laying these maps before the Society, and presenting this *ad interim* report of progress, is to appeal to some other man of science, if not in England, then in some other country, to come forward to aid in the work, which it is improbable that I, with my small observational means and limited time, can carry to a termination. I reckon that, having regard to routine solar work, it will require another year before the portion from H to G is completely finished, even for the metals the spectra of which are shown in the maps now exhibited. When this is done there will still remain outstanding all the ultra-violet portion, the portion from G to F, both capable of being photographed by short exposure, and the whole of the less refrangible part, which Draper and Rutherford have both shown can be reached by long exposure with the present processes.

I cannot but think, moreover, that when the light which the spectroscope has already thrown upon molecular action shall be better known, and used as a basis for further inquiry, methods of photography greatly exceeding the present one in rapidity, in the less refrangible portion of the spectrum, will be developed and utilised in the research.

The map is being drawn by my assistant, Mr. Raphael Meldola (to whom my thanks are due for the skill and patience he has brought to bear upon the work), in the first instance with more especial reference to the positions, thicknesses, and individualities of the lines; the final revision will consist of an absolute intensity reproduction of the photographs.

"On the Spectrum of Coggia's Comet," by William Huggins, D.C.L., LL.D., F.R.S.

From his observations of five small comets in the years 1866, 1868, and 1871, the author had shown that a great part of the light of those comets was emitted by the cometary matter; and further, that carbon, in some form, was probably present in them.

Coggia's Comet presented in the spectroscope three distinct spectra :—

1. A continuous spectrum from the light of the nucleus.
2. A spectrum of bright bands.
3. A continuous spectrum accompanying the gaseous spectrum on the coma, and representing almost entirely the light of the tail.

The author then gives his observations of three different spectra, and of the relative intensity of the two latter spectra in different parts of the comet.

On acoustic reversibility, by J. Tyndall, D.C.L., LL.D., F.R.S. In this paper Prof. Tyndall refers to the series of experiments on the velocity of sound which were made on the 21st and 22nd of June, 1822, between Villejuif and Montlhéry, south of Paris, and 11·6 miles distant from each other.

On this occasion it was noticed that while every report of the cannon fired at Montlhéry was heard with the greatest distinctness at Villejuif, by far the greater number of the reports from Villejuif failed to reach Montlhéry. The air at the time was calm, the slight motion of translation actually existing being from Villejuif towards Montlhéry, or against the direction in which the sound was best heard.

So far as the author knows, no explanation of this has hitherto been given.

Experimenting with a sensitive flame, from 18 to 24 inches in height, and a reed, less than a square quarter of an inch in area, on a screen of cardboard, 18 inches high by 12 inches wide, in all cases it was shown that the sound was effective when the reed was at a distance from the screen and the flame close behind it ; while the action was insensible when these positions were reversed.

It was observed and recorded when the experiments of 1822 were made, that while the reports of the guns at Villejuif were without echoes, a roll of echoes, lasting from twenty to twenty-five seconds, accompanied every shot at Montlhéry, being heard by the observers there.

From various considerations the author infers that Montlhéry, on the occasion referred to, must have been surrounded by a highly diacoustic atmosphere ; while the shortness of the echoes at Villejuif shows the atmosphere surrounding that station to have been acoustically opaque.

The non-homogeneous air surrounding Villejuif is experimentally typified by the screen with the source of sound close behind it ; the upper end of the screen representing the place where equilibrium of temperature was established in the atmosphere above the station. In virtue of its proximity to the screen, the echoes from the sounding-reed would, in the case here supposed, so blend with the direct sound as to be practically indistinguishable from it, as the echoes at Villejuif followed the direct sound so hotly, and vanished so rapidly, that they escaped observation. And as the sensitive flame, at a distance, failed to be effected by the sounding body placed close behind the cardboard screen, so, the author takes it, did the observers at Montlhéry fail to hear the sounds of the Villejuif gun.

Something further may be done towards the experimental elucidation of this subject. The facility with which sounds pass through textile fabrics has been already illustrated ; * a layer of cambric, or even of thick flannel or baize, being found competent to intercept but a fraction of the sound from a vibrating reed. Such a layer of cambric may be taken to represent a layer of air differentiated from its neighbours by temperature or moisture ; while a succession of such sheets of cambric may be taken to represent successive layers of non-homogeneous air.

Two tin tubes with open ends were placed so as to form an acute angle with each other. At the end of one is the vibrating reed ; opposite the end of the other, and in the prolongation of its axis, is a sensitive flame—a second sensitive flame being placed in the continuation of the axis of the first tube. On sounding the reed, the direct sound through the first tube agitates the second flame. Introducing the square of cambric at the proper angle, a slight decrease of the action on the second is noticed, and the feeble echo from the cambric produces a barely perceptible agitation of the first flame. Adding another square, the sound transmitted by the first square impinges on the second. It is partially echoed, returns through the first square, passes along the second tube, and still further agitates the flame opposite its end. Adding a third square, the reflected sound is still further augmented, every accession to the echo being accompanied by a corresponding withdrawal of the vibrations from the flame opposite the first tube, and a consequent stilling of that flame.

With thinner cambric it would require a greater number of layers to intercept the entire sound. Hence, with such cambric, we should have echoes returned from a greater distance, and, therefore, of greater duration.

* Phil. Trans., Feb. 1874.

Jan. 14.—"On a Class of Identical Relations in the Theory of Elliptic Functions," by J. W. L. Glaisher, M.A., Fellow of Trinity College, Cambridge; communicated by James Glaisher, F.R.S.

Chemical Society, Jan. 14.—Prof. Odling, F.R.S., president, in the chair.—On the action of the organic acids and their anhydrides on the natural alkaloids, Part III., by Mr. G. H. Beckett and Dr. C. R. A. Wright, was read by the latter. It is a continuation of their researches on the opium alkaloids morphine and codeine.—The next communication was a note on the effect of passing the mixed vapours of carbon bisulphide and alcohol over red-hot copper, by Mr. T. Carnelly.—Dr. H. E. Armstrong then read a paper on the iodonitrophenols.

Anthropological Institute, Jan. 12.—Prof. Busk, F.R.S., president, in the chair.—Mr. T. J. Hutchinson, F.R.G.S., late H.M.'s Consul, Callao, read a paper on the anthropology of Prehistoric Peru. The paper commenced with a notice of how little is known up to the present time about the glorious days of Peru long before the time of the Incas, agreeing with Mr. Baldwin as to the original South Americans being the oldest people on that continent. The grandeur of colossal works in the extent of the ancient burial mounds was shown by illustrations. A comparison of these examined by the author in Peru was made with those explored by Messrs. Squier and Davis in the valleys of the Ohio and the Mississippi. The prehistoric architecture of Peru, described by Prof. Raimondi in his recent work on the mineral riches of the department of Ancachs, were mentioned as highly interesting ; more particularly the tombs cut out of solid blocks of diorite in the valleys where sandstone is the geological character ; thus proving the enormous capacity for work of the ancient Peruvians in transporting these stony masses over the Andes. So small was the author's faith in Spanish accounts of South America, that he inclined to the belief in some future explorer finding the mythical "cradle of the Incas" in the National Library at Madrid, instead of in the Lake of Titicaca, to which latter place it is accredited by the Hakluyt Society.—A paper, by Dr. George Dobson, was read on the Andamans and Andamanese. After giving a sketch of the geographical position of the Andaman Islands and their geological and zoological relations to the Asiatic continent, the author passed in review the various theories that had been propounded by eminent biologists to account for the origin of the Andamanese. He strongly inclined to the views of Mr. Wallace and M. Quatrefages that the Andamanese are Nigritos, or Samangs from the Malay peninsula, and was opposed to the theory of their descent from shipwrecked African negroes, on the ground rather of the dissimilarity of their manners and customs than of their physical characteristics. It was impossible, however, to account for the presence of the wild tribes of Southern India or of the peculiar Samangs of the interior of the Malay peninsula, surrounded by races with which they have no connection whatever, except on the hypothesis that they are the few surviving descendants of a woolly-haired people which in ages past occupied lands south of the Himalayas when the continent of Asia included within its southern limits the Andamans, Nicobars, Sumatra, Java, Borneo, and the Philippine Islands ; and that the present inhabitants of the Andamans and the Nigritos of the Philippines are also the remnant of those ancient Nigrito inhabitants of Southern Asia, which have almost disappeared before the invading Aryan and Mongolian races. Dr. Dobson exhibited a series of photographs, taken by himself, of Andamanese men and women.

Entomological Society, Jan. 4.—Sir Sidney Smith Saunders, C.M.G., president, in the chair.—Mr. Stevens exhibited varieties of *Diloba cæruleocephala* and *Hibernia defoliaria*, bred from larvæ taken near Brighton.—Mr. Smith exhibited a box of hymenopterous insects collected in the neighbourhood of Calcutta by Mr. Rothney. It comprised several rare species of *Formicidæ* and *Fossores*, and also many undescribed species of *Apidæ*, amongst which were two species of *Nomia*, one of them with remarkable capitate antennæ.—Mr. M'Lachlan made some remarks on the December Moth (*Cheimatobia brumata*), which he had observed one evening during the recent severe frost

attracted in great numbers to the gas lamps in the neighbourhood of Lewisham. Mr. Weir remarked on the importance of ascertaining whether they were hybernated specimens or whether they had been newly hatched during the severe weather.—A letter was read from Mr. R. S. Morrison, of George Town, Colorado, expressing a wish to be placed in communication with any entomologists who might be interested in the insect faunas of the higher altitudes (8,000 to 14,000 ft.), which he considered should be more fully investigated.—The Secretary exhibited a small bottle containing specimens of a *Mantis*, forwarded to him from Sarawak by Mr. de Crespigny. He stated that while sitting at table his notice was attracted by the unusual appearance of a column of ants crossing it; but on looking more narrowly he observed that they were not ants, but a species of *Mantis*, and he believed them to be full grown insects, but that they had no wings. Mr. M'Lachlan, however, observed that some of the specimens had rudimentary wings; and the President and others expressed a belief that they would prove to be larvæ, and not perfect insects.

Institution of Civil Engineers, Jan. 12.—Mr. Thos. E. Harrison, president, in the chair.—The paper read was on the construction of gasworks, by Mr. Harry E. Jones.

BERLIN

German Chemical Society, Dec. 19.—Annual ordinary meeting; A. W. Hofmann, V.P., in the chair.—The vice-president reported on the state of the Society, which counts 1,209 members, while the reports are published to the number of 1,800 copies. The number of papers published through its means amounted to more than 500 during the last year. The elections called the resident officers back to their posts, while, as non-resident members of the committee, the following were elected for the new year:—Messrs. Baeyer, Griess, Ladenburg, Landolt, and Schorlemmer.

Dec. 28.—A. W. Hofmann, V.P, in the chair.—P. Wallach and A. Böhringer, in treating methylated oxamine with PCl_5, have produced a well-defined base yielding well-crystallised monobasic salts and a direct combination with C_2H_5I. The base $C_4H_5ClN_2$ has received the name chloroxal methyline, and is homologous with $C_6H_9ClN_2$ lately produced by Dr. Wallach from ethylated oxamine in a similar way.—I. Piccard has succeeded in producing anthrachinone by heating, in closed tubes to 220°, benzol and phthalic chloride with zinc:

$$C_6H_4\begin{matrix}COCl\\COCl\end{matrix} + C_6H_6 = C_6H_4\begin{matrix}CO\\CO\end{matrix}C_6H_4$$

I. Siebel proposed as a method for producing soda the treatment of tribasic phosphate of soda with carbonic acid, adding subsequently carbonate of ammonia. The double phosphate of sodium and ammonium crystallises out, while two-thirds of the sodium, transformed into carbonate, remain in solution.—A. Oppenheim reported on a mechanical method for preventing the most frequent cause of the incrustation or furring of steam boilers, lately patented by a large boiler-maker, M. Paukoch, in Landsberg. Instead of introducing the water directly into the boiler, he lets it run slowly through a wide tube passing through the boiler. Here, on being heated, the water deposits its carbonate of lime before it is admitted into the boiler. As the inner tube is not in contact with the fire, the deposit in it cannot produce the usual dangerous results.

PARIS

Academy of Sciences, Jan. 11.—M. M. Fremy in the chair.—The following papers were read:—On the mesaticephalic and brachycephalic fossil human races, by M. de Quatrefages, being the third part of the author's and M. Hamy's work on the skulls of the human races.—Report on M. Alph. Guérin's work, on the patho-genetic effect of fermentation products in surgical cases, and a new method of treatment of the amputated, by M. Gosselin.—MM. Bouilland and Pasteur then spoke in detail on the same subject; M. A. Trécul made some observations with regard to the production of vibriones and bacteria, in reference to the last subject.—Report on M. Halphen's memoir, concerning the important points of plane algebraic curves, by M. de la Gournerie.—On the existence of the integral in equations with partial derivatives, containing any number of functions and independent variables, by M. G. Darboux.—On the action of electrolytic oxygen on alcohol, by M. A. Renard; experiments made by the author, who exposed alcohol, to which about five per cent. of dilute sulphuric acid had been added, to an electric current from four to five Bunsen cells, and analysed the products after forty-eight hours' action: he found ethylic formiate and acetate, aldehyde, acetal, ethyl-sulphuric acid, and a new substance, ethylenic-monoethylate, which may be regarded as an acetal $\left.\begin{matrix}C_2H_5O\\C_2H_5O\end{matrix}\right\}C_2H_4$, in which one C_2H_5 is replaced by H, thus possessing the formula $\left.\begin{matrix}C_2H_5O\\HO\end{matrix}\right\}C_2H_4$.—On the "*seiches*" of Lake Leman, by F. A. Forel. *Seiches* are the sudden rises and falls in the level of this lake. The author gives an explanation of these phenomena and considers them constant and frequent in all larger lakes, and not rare and accidental as was believed hitherto.—A note by M. Martha-Becker, relating to his paper on ether and the origin of matter.—A note by M. H. de Kerikuff, with corrections for his communication on the velocity of light and the parallax of the sun.—A note by M. Poupelle, with regard to a system of electric danger signals to prevent railway collisions on a single line of rails.—On the reduction of equations with partial derivatives to ordinary differential equations, by M. W. de Maximovitch.—M. E. Flaquer communicates the observations and calculations made by the French Commission for the measuring of the arc of meridian between Barcelona and the Balearic Isles.—M. Lemonnier gives some new theories with regard to equations with common roots.—On the correction of Descartes' ovals, by M. A. Genocchi.—On some properties of the curvature of the surfaces, by M. Halphen.—On stratified light, by M. Neyreneuf.—On the specific rotative power of mannite, by M. G. Bouchardat; accounts of experiments made in M. Berthelot's laboratory.—M. P. Bouloumié communicates the results of his observations and researches on micro-organisms in suppurations, their influence on the healing of wounds, and the different means to prevent their development.—On white globules in the blood-vessels of the spleen, by MM. Tarchanoff and A. Swaen.—On the habits of a remarkable serpent of Cochin China: *Herpeton tentaculatum*, by M. A. Morice.

BOOKS AND PAMPHLETS RECEIVED

BRITISH.—On the Recent Progress and Present State of Systematic Botany: George Bentham, F.R.S. (British Association).—Institution of Civil Engineers (Printed by Private Press).—Agricultural Gazette Almanack, 1875 (W. Richards).—Westminster Review, January 1875 (Trübner).—The Nágpúr Waterworks: James Forrest (Clowes and Sons).

FOREIGN.—Note sur un procédé pour donner ou pour rendre leur couleur rouge aux muscles Conservés dans l'alcool: Félix Plateau (F. Hayez, Bruxelles).—Un parasite de l'Heiroptères de Belgique: Félix Plateau (Académie Royale de Belgique).—Die Lösung der wichtigsten probleme in der Natur: Johann Friedrich Lochner (E. H. Mayer, Leipzig).—Les Comètes: Amédée Guillémin (Paris, Hachette and Co.).—In Sachen Darwin's insbesondere Contra Wigand: Dr. Gustav Jaeger (Stuttgart, E. Schweigerbart).—Annuaire de l'Académie Royale des Sciences, des Lettres, et des beaux-Arts de Belgique, 1875 (Brussels, F. Hayez).—Third Annual Report of the Director of the Imperial Mint, Osaka, Japan. Year ending July 31, 1874 (*Hiogo News* Office).—Der Darwinismus und der Naturforschung Newtons und Cuviers: Dr. Albert Wigand (Brunswick, F. Vieweg und Sohn).

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DIARY OF SOCIETIES.

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THURSDAY, JANUARY 21.

ROYAL SOCIETY, at 8.30.—On the Origin and Mechanism of Production of the Prismatic (or Columnar) Structure of Basalt: R. Mallet, F.R.S.—On the Anatomy of the Connective Tissues: Dr. Thin.
LINNEAN SOCIETY, at 8.—On the Pathology of Oak-Galls, &c.: Dr. Hollis.—On the Nature of several Atolls in the South Pacific: Rev. T. Powell.—Papers on the Botany and Entomology of the *Challenger*.
SOCIETY OF ANTIQUARIES, at 8.30.—Further Notes on St. Hugh's Work in Lincoln Cathedral: J. H. Parker, C.B., F.S.A., and Sir G. G. Scott, R.A., F.S.A.
ROYAL INSTITUTION, at 3.—Physical Geography: Prof. P. M. Duncan.
LONDON INSTITUTION, at 7.—Early Inhabitants of England: Prof. Rolleston, F.R.S.

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SOCIETY OF ARTS, at 8.—Indian Section; Opening Address: Sir George Campbell.

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LONDON INSTITUTION, at 5.—Cremation: Mr. Armytage Bakewell.

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ROYAL INSTITUTION, at 3.—Pedigree of the Animal Kingdom; E. Ray Lankester.
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WEDNESDAY, JANUARY 27.

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LONDON INSTITUTION, at 7.—First Musical Lecture: Prof. Ella.

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MONDAY, JANUARY 25.

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NATURALISTS' FIELD CLUB, at 8.—Organisation of *Daphnea pulex*: Thos. Tate.

MANCHESTER

TUESDAY, JANUARY 26.

GEOLOGICAL SOCIETY, at 3.

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